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ELEMENTARY BOTANY,

FOR

THE USE OF BEGINNERS,

BY

T. S. RALPH, A.L.S. &c.

LONDON:
WILLIAM PAMPLIN, 45, FRITH STREET, SOHO.

1849.

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To Rose
from
Jan Oct 1st 1931

INTRODUCTION.

THE object with which the "ELEMENTARY BOTANY" has been written, is not to make Botanists of the students or readers of it, but to convey such an amount of information upon the subject to the generality of learners and especially to the younger portion, as shall be a sufficient guide to them to pursue the Study still further.

The plan which has been adopted is as simple as the Author has found it to be in his power to follow out, and one which he thinks has not yet obtained in this Study, that of commencing with *simple views* of complex objects, and afterwards of admitting combinations of various kinds, introduced as gradually as the subject will admit of.

The ground which Botany, as a Study, has been gaining of late years, would lead to the expectation that a more rational view is entertained of this part of Natural History, than the idea that it is a mere acquaintance with a number of difficult names of plants or parts of plants;—that it is, in reality, a Study which calls for a careful observation of facts, forms, and structure, just as exact and extended as those which are needed in the Sister Study, Zoology.

To those who are led to regard the subject as one of mere hard names, and are thereby deterred from its Study, it is needful to state, that as few as possible of such terms have been employed, and when so employed, will generally be found accompanied with some familiar expression which can be adopted as a substitute, or equivalent. About eighty or a hundred words of Latin derivation suffice, if properly selected, as an ample store of terms to a young Botanist, or to any one who wishes to be acquainted with the amount of information which has been aimed at in the following pages, and which, (if taken as a whole) will be found sufficient for the generality of those who make this subject their ordinary Study.

Ample reference to figures has been employed and occasionally repeated, in order to bring into one plate, subjects which need comparison in various ways.

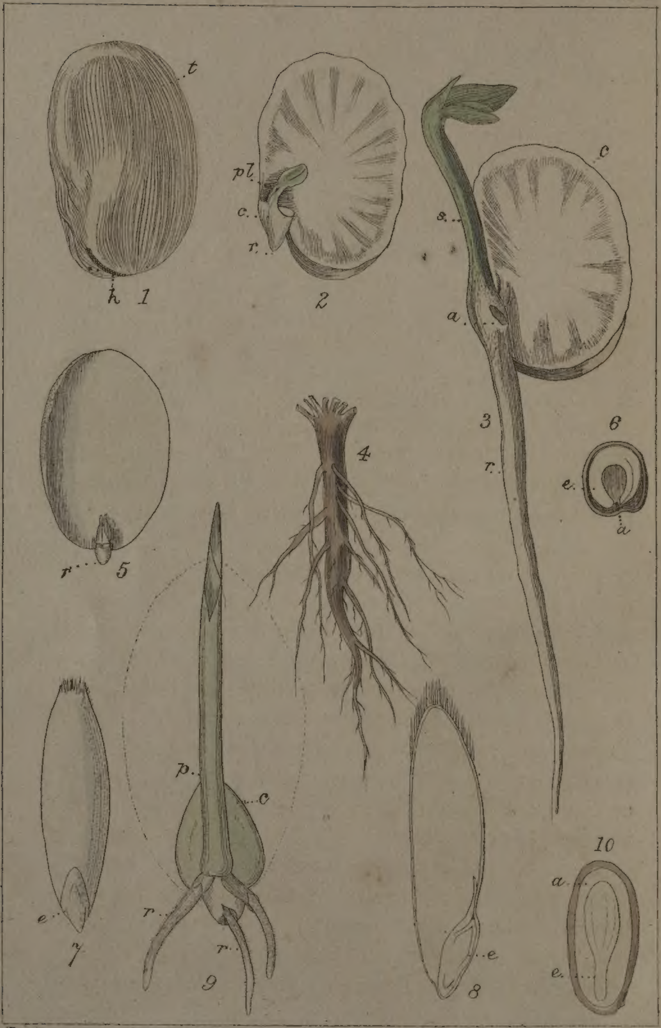
The objects which have been selected as illustrations, are either easy of access as specimens of wild plants, or are common in gardens. The Author would impress upon those who may employ this work in teaching, the necessity of making the student follow out the illustrations given, by examining specimens collected for the occasion, and of detaching the parts examined from all adjoining organs, that a definite idea of the object studied may be obtained.

The present work is intended to be followed by one on the same plan, which will treat of Descriptive Botany.

T. S. R.

Berners Street,
London, *July*, 1849.

Pl. 1.



T.S.R.

ELEMENTARY BOTANY.

The Seed being a very constant product, and one of the most important organs of a plant, an examination of its general structure will furnish a good subject with which to commence the study of Botany:—

1. On examining a Pea or a broad Bean, (pl. i. f. 1. *h.*) a mark or scar will be found at one end, which indicates the point or part by which the seed was attached to the parent plant, this is called the *hilum*; through it the nourishment needful for perfecting the seed was conveyed to it from the plant. The smooth white coat which covers the seed can be removed by soaking it in warm water for a short space of time, and then the following parts will be apparent: the shell or *testa*, which is of a lighter colour within; the *kernel*, which is white and can be readily separated into two portions of equal size; these two are termed the *seed-lobes*, of which one only is to be seen in f. 2 and 3. At that part of these seed-lobes which is nearest to the scar (or *hilum*) on the shell, may be

observed a small body, called in common language the "heart;" (f. 2. *c.*) it is the essential part of the future plant in a very diminutive state, and the two seed-lobes are two storehouses of food to this little plant, as will be seen by and bye.

These three parts, the two seed-lobes and the heart (or *corculum*), are very constantly present in the generality of seeds; but the Bean, Lupin, Pea, Almond, Walnut, Apple, Pear and Acorn, furnish some of the better examples for examination.

2. In order to ascertain the nature and uses of these parts, let them be examined under the effects of a natural process. First, let a few Beans be placed in water for a day or two, and then let them be sown in pots or in the ground, and examine them from time to time. When placed in water even for a few hours, each seed will be found to have become heavier and increased in size, which circumstance is owing to the water having penetrated the shell or testa: next, the testa will burst, because the seed-lobes have swollen still more. At this point if a Bean is examined, the seed-lobes will be found to separate very easily, and the heart will be increased in size. Let those also be examined which have been a day or two in the ground, and note the progress which they have made: the seed-lobes will be found much swollen, and the corculum or heart will be still more increased in size, so as to be readily distinguishable into two parts, one which tapers into a root like form (f. 3. *r.*) and the other (*s.*) which has already commenced shooting upwards into a greenish stalk or stem-like part; in fact that

the heart consists of a root and a stem in miniature. When the seed is examined after it has put forth its stem from the ground, the rootlet will be found to be increased to some extent, and to have taken a direction downwards, while the stem part has risen upwards. At a later period the seed-lobes will shrivel in the shell or testa, having given up what they contained for the nourishment of the young plant, which at this stage of its existence is able to grow without them.

3. The following then are the most remarkable parts to be remembered in the seed: the scar or hilum (f. 1. *h.*), the shell or testa *(t.)*; the two seed-lobes or *cotyledons* (*c.*), and the heart or corculum, (f. 2. *c.*) which consists of the rootlet or *radicle* (*r.*), and the stem-like part or *plumule* (*pl.*). The hilum having served for the passage of nourishment to the young seed while growing on the plant, and for the transmission of water in part while vegetating or germinating. The testa or shell being a protecting cover to the kernel, but able also to admit water to the interior while vegetation is going on.

The seed-lobes or cotyledons are reservoirs or containers of nourishment for the heart, to which they impart it whenever this organ begins to grow, which occurs when the seed is placed under circumstances favourable to this end The radicle and plumule together compose the germ of the young plant, waiting in the seed the time when circumstances favourable to its growth shall be presented to it; which are, first, moisture, next air and heat; without which the seed cannot make any progress in growth: the moisture serves to dissolve the nourishment laid up in store; the heat enables changes to take place in the seed; and the air is necessary to assist these changes.

4. The radicle or rootlet which the seed pushes out, is of a conical or taper form, and always takes a downward direction, whatever may have been the position of the seed when placed in the ground:—while the plumule or stem as constantly takes the upward or ascending; the former seeks the soil and darkness, and is usually white, the latter is greenish and requires light and air. The root soon passes from this simple form and takes some other (f. 4.) by dividing into a number of finer parts; but generally there is a main or principal root, and many small ones branching off from it, as in the Radish, &c. Each little root or fibre of the root ends in a fine point, which enables it to take up the moisture, &c. which is in the earth, and which is then conveyed to the main stem, through which it is carried to the other parts of the plant. If these fine points are cut off from a plant, it will die, unless it is able to produce more, as the greater part of the nourishment which the plant obtains from the earth can only pass through these fine parts: hence the necessity of great care being taken in the removal of plants from one part of a garden to another.

OF THE STEM GENERALLY.

5. In proportion as the radicle or rootlet of the young plant lengthens and becomes a root with fibres, at the same time and to some similar extent does the plumule, or ascending portion, assume the form of a stem, and all those parts which belong to the stem of a plant.

As this stem lengthens, it unfolds what are commonly known as leaves, which when the plant is fully grown usually form its principal and most permanent beauty: they are considered as additions or appendages to the stem, as they are thrown off after a certain season, or when they have done their work in the plant. The stem in the young plant, and in those which do not attain any great size or age, is of a green or greenish tint; and when the plant grows older this colour changes to brown; as may be seen in trees and shrubs, in which all the new shoots will be found to be green during the first year of their existence, and brown during the remainder.

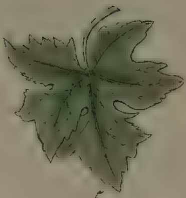
6. A great difference exists in the forms of the stems of plants, for while some are straight and do not divide, others are much divided or branched; some stems rise up from the ground, while others lie on it; others again twine round their neighbours, as in the Convolvulus or Bindweed. All these are various kinds of stems, but as a general rule, whatever part of a plant is above ground, of a greenish or greenish-brown colour, may be considered as a stem or belonging to the stem; while all below the ground as belonging to the root, which is of a lighter colour and never green.

OF THE LEAF.

7. All are well acquainted with what is called the *leaf* of a plant; it is generally a flattened, thin, almost always green body of variable size and form, situated on the stem or branches of a plant. Take for example an Apple or Lilac leaf; first, there is a broad thin part

which is called the *blade* (pl. 2. f. 1. *l.*), and is the principal part of the leaf; to this blade there is a stalk (*p.*), on which the blade is supported and joined to the stem, this is called the *leaf-stalk:* the rounded part of the blade, where it joins the leaf-stalk, is called the *base,* and the narrow end, or point, the *apex* of the leaf; the edges are termed the *margins.* On examining the blade on its under surface, or that which is turned towards the ground while the leaf is on the plant, it will be found to be of a lighter colour than the upper, and the leaf-stalk will be seen passing in the form of a vein from the base to the apex of the leaf; this is called the *mid-vein,* or *mid-rib* of the leaf, and from it may be seen passing a number of other ribs, or veins as they are usually called, towards the edges or margins of the blade.

8. The principal parts then of a leaf are as follows (pl. 2.), the *leaf-stalk,* called also the *petiole,* the *blade* or *limb* of the leaf, the *base,* which is always directed towards the stem, the *apex,* the edges or *margins,* the *upper* and the *under surface,* the upper being generally darker than the under, which has the mid-rib and veins much more strongly marked upon it than the upper. Through the leaf-stalk a number of fine fibres pass into the blade and divide there in the form of veins, which will be more readily seen by holding the leaf up to the light; these veins form the frame-work or skeleton of the leaf (pl. 2. f. 1.), while all the spaces between the net-work of veins are filled up with a delicate thin green substance. Skeleton leaves are found at the latter end of autumn, in consequence



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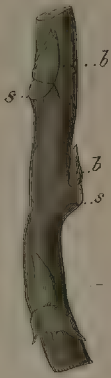

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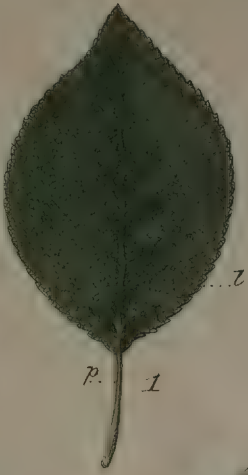

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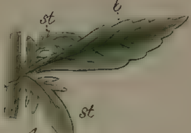

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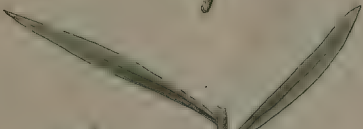

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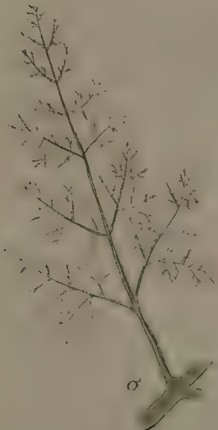

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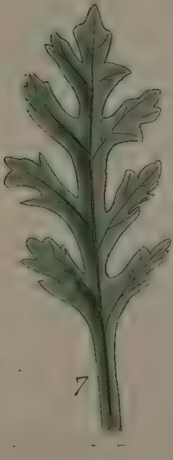

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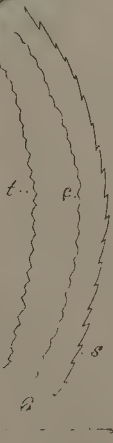

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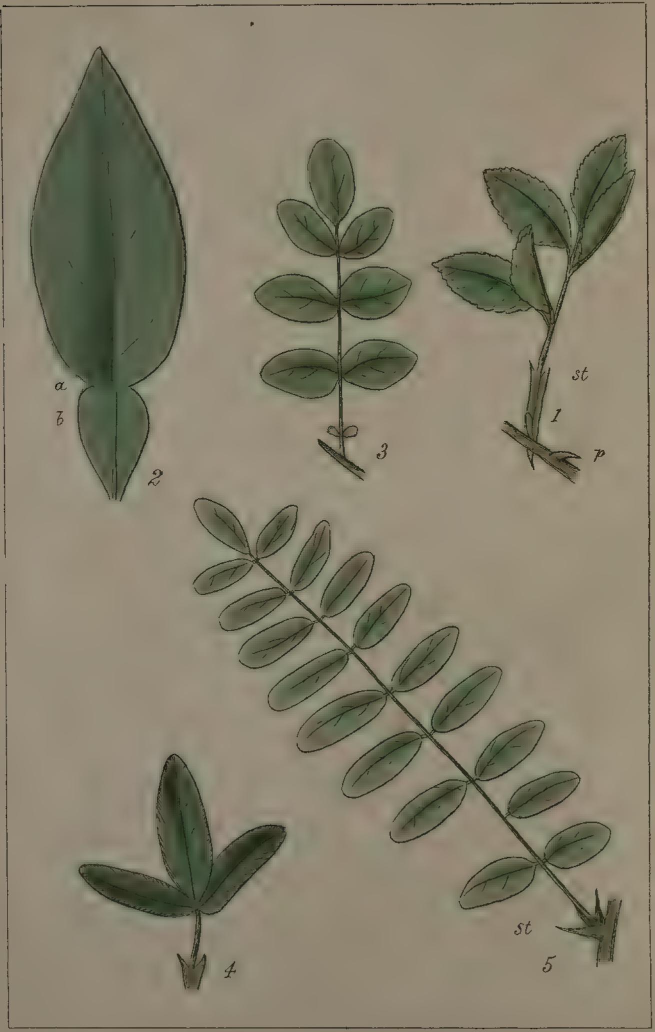

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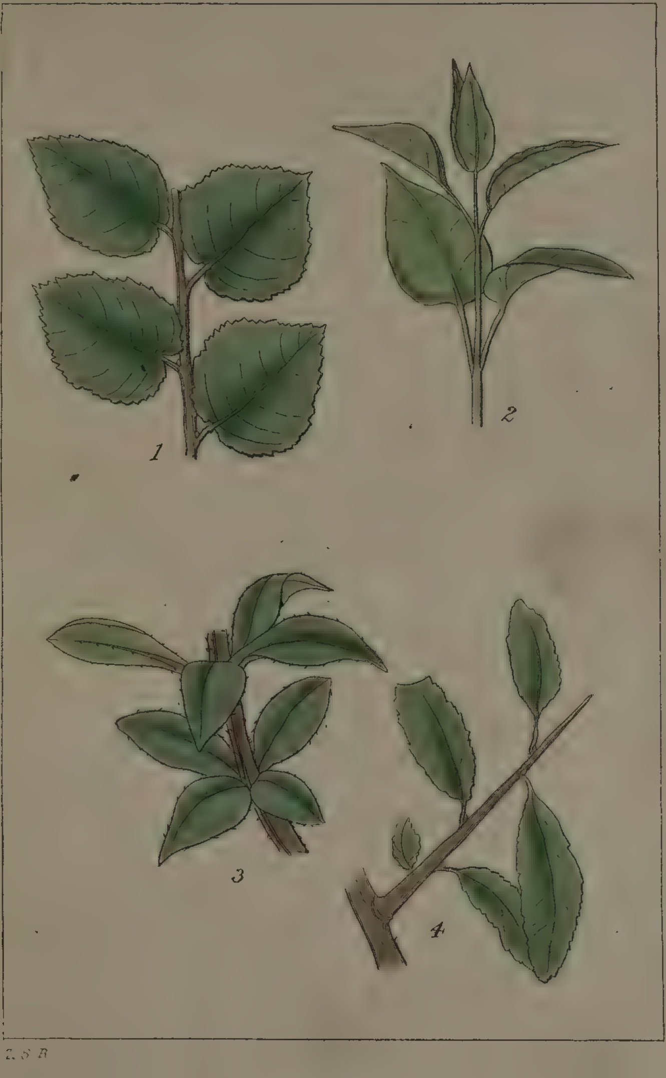
of the decay of the green substance of the leaves from long exposure on the wet ground; but the full grown leaf of the Poplar and of some other trees, if soaked in water for two or three weeks and then carefully cleaned with a camel's hair brush, will yield a good frame-work of the leaf; but in making the experiment choice should be made of only such leaves as are free from holes in the blade, or from spots or blisters, as these last will not come off clean, but will break away during the preparation. The veins not only give the blade its form, but as they are the vessels of the stem which pass out into the blade and back again into the stem through the leaf-stalk, they serve also to convey the proper juices of the plant.

9. The leaf-stalk or petiole is almost always united to the stem by a joint, as may be seen by breaking it off from the stem; on which the marks or scars of the leaves which have fallen off can frequently be found (f. 2. *s.*). The leaf-stalk is not present in all leaves, and then the blade joins the stem at its base, and is called a *sessile* leaf (f. 3.); while one with a leaf-stalk is termed a stalked or petiolate leaf. In some leaves, as for instance in the Rose and Violet, where the leaf-stalk joins the stem, two small leafy organs are to be seen, one on either side, these are considered to be additions to the leaf, and are termed *stipules* (pl. 3. f. 1. *st.*): they are sometimes very large and are mistaken for the leaves, as in the Violet and Heartsease (pl. 2. f. 4. *st.*).

10. Leaves assume very varied forms and appearances, and yet by their forms are plants often recognized and

known. The leaf of the Lilac for example, is of a form which is one of the most simple, as the blade is *entire* (pl. 4. f. 1), that is the margins are not divided or notched in any way; while the leaf of the Vine (pl. 2. f. 5.), Ivy, Oak, Dandelion, Mallow, Gooseberry, Hawthorn, &c. are examples of *divided* leaves; the margins or edges of these leaves being more or less cut, or divided, so as to give the blade the appearance of being lobed, or parted into different portions. The *entire* leaf may vary in its form, as in the Lily, in which it is long and narrow, or it may be round or nearly so, as in the Garden Nasturtium (pl. 11. f. 2.).

The following are some of the more frequent forms of the *divided* leaf, or rather of the *entire* leaf passing into the divided leaf; when the margin is divided into teeth like those of a saw, the points being directed towards the end or apex of the leaf, it is termed a *serrated* leaf, or cut like a saw: as in the Elm, Nettle, &c. (pl. 2. f. 6. *s*.). When the margin is furnished with regular cuttings, that is not pointing to either end of the leaf, it is then called a *crenate*, or notched leaf, as in the Dead Nettle (f. 6. *c*.). When the cutting of the margin is very small, the leaf is then said to be *toothed* (f. 6. *t*.); and when the margin is cut irregularly as to size and distance, it is termed a *jagged* leaf. When the margins of the leaf are divided still more deeply, the leaf becomes *lobed*, as in the Vine (f. 5.), Ivy, Currant, Gooseberry, Prickly fruited Poppy, (f. 7.). In the Fennel, &c. the whole leaf loses its margins, and presents only a kind of green framework, or skeleton; it is then called a *decompound* leaf, (f. 8.)



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11. All true leaves can be arranged or classed into two kinds; the *simple* leaf, in which the blade is either entire or divided, and the *compound* leaf, which at first sight appears to be a kind of divided leaf, but when carefully examined proves to be very different in its character.

In order to explain the nature of the compound leaf, it will be necessary to examine one or more of the following examples:—

a. The leaf of an Orange Tree (pl. 3. f. 2.), when first examined appears to be a simple leaf, placed upon a leaf stalk; but observe a small character in its structure which proves it to be a *compound* leaf, *viz.* that where the blade joins (*a.*) the leaf-stalk, there is a joint, and the blade easily falls off at this part; as easily as the leaf-stalk does from the stem itself. This character cannot be found in the leaf of the Lilac, Lime, Apple, or in any of the leaves already mentioned. On further examination of the sides of the leaf-stalk of the Orange, it will be seen that there is a leafy part (*b.*), seldom to be met with in simple leaves, but which corresponds to the other parts of a compound leaf. In the common Jasmine the leaf appears to be divided, but each portion will be found to be jointed to the leaf-stalk, as the single blade of the Orange is to its own petiole. This blade of the Orange answers to the little end leaf of the Jasmine, while the two small leafy parts on the leaf stalk correspond to two little leaves, one on each side of the petiole of the Jasmine.

b. Compare the leaf of the Jasmine with that of the Water Cress (f. 3.), which is deeply divided down to the leaf-stalk, and much resembles a compound leaf, but is in reality a simple one; for each little leaf is completely united with the leaf-stalk, and cannot be separated from it without tearing either one or the other; while the little leaves of the Jasmine can be made to fall off at a little joint which exists between each little leaf and the leaf-stalk.

c. Again, the leaf of the Laburnum, Trefoil, or Clover, is a *compound* leaf, as each little leaf is jointed to the leaf stalk; so also the little leaves of the Robinia or *False Acacia* (f. 5.), of the Bladder Senna, and Rose Tree (f. 1.), are jointed to the leaf-stalk; in f. 5. a little leaf has been removed, showing the way in which these parts of the compound leaf sometimes fall off of their own accord.

The character then of a *simple* leaf is, that neither the blade nor any of its divisions separate from the leaf stalk or petiole: and that the *compound* leaf consists of a leaf-stalk which supports a number of little leaves, (called also *leaflets*), each of which are jointed to it, just as the leaf-stalk is to the stem of the plant.

OF THE ARRANGEMENT OF LEAVES ON THE STEM.

12. Leaves not only give a character to the plants to which they belong by their colours and forms, but also by the manner in which they are placed or arranged on their stems. This will be soon apparent by comparing some of the following examples; for instance, the leaves of the Currant, Gooseberry, Elm, Oak, and Lime Tree (pl. 4. f. 2.), are very differently arranged on their stems to those of the Lilac (f. 1.), Mint, Dead Nettle,

or Pink. In the Currant, &c. the leaves are placed singly on the stem, and each a little higher and opposite to the one below; while in the Lilac, &c. they are arranged in pairs, one opposite the other; in the former (Currant, &c.) the leaves are said to be *alternate*, in the latter (Lilac, &c.) *opposite*. There is one other mode of arrangement, which is not so common as the foregoing, and consists of 3, 4, 5, 6, or more leaves, placed in a circle round the stem, forming what is called a *whorl*, or *verticel*, as for example, in the Bedstraw, Woodruff, Cleavers, and Madder, (f. 3).

In order to show how great a difference the mere arrangement of the leaves on a stem makes in the appearance of a plant, let the following experiment be tried : pull off from a Lilac branch every other leaf in turn, beginning with the lowest right hand one; next take off the lowest but one on the left, then remove the one which is next but one above that which remains on the right, and so on, taking away every other leaf in alternate succession, and when all these have been removed, the branch will appear to be furnished with *alternate* instead of opposite leaves, and a comparison with one in the natural state will exhibit the great difference the plant would present if the leaves had been arranged *alternately*.

BUDS.

13. Take almost any *woody* plant which is in full leaf, and examine it carefully at the part where a leaf joins the stem, and a small green body will be found growing there: this is commonly known under the

name of a *bud*, (pl. 2. f. 2. *b*.); it consists of a number of little leaves closely packed together on a stem, waiting the next season to push itself out into a new branch furnished with fresh leaves. These buds are formed during the summer and autumn, and remain in an inactive state during the winter, when they are protected from the influence of the wind and cold by a number of scales or outer leaves. The buds swell in early spring, and throw off these scales and then begin to extend into new branches, which are green during the first summer, as already noticed, and becoming of a brownish tint during autumn, remain unchanged as to colour, for the remainder of the life of the plant.

INFLORESCENCE.

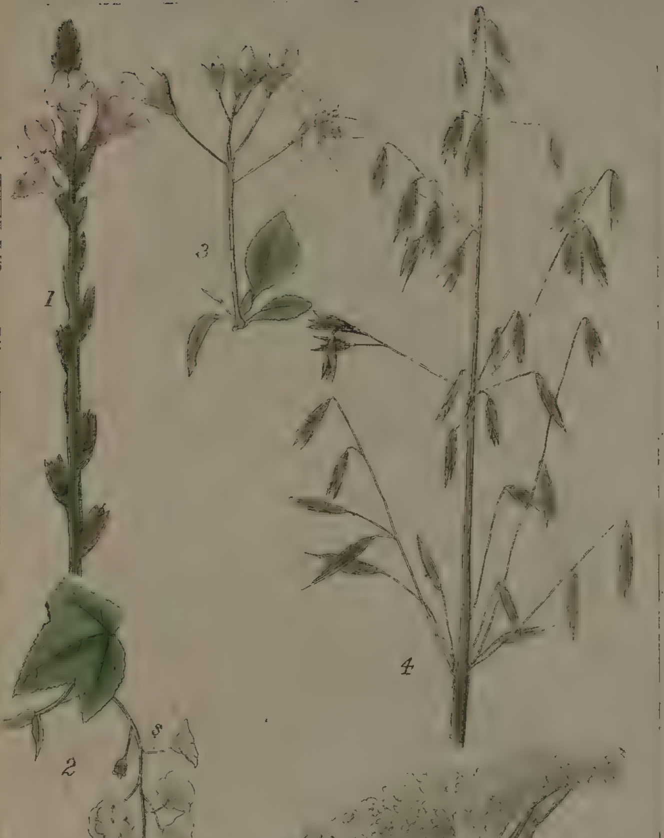
14. As leaves are variously arranged on the stems of plants, so are flowers differently placed on the branches which bear them. This arrangement is termed *Inflorescence* or manner of flowering.

On examining a Plantain or Verbena (pl. 5. f. 1.) in bloom, it will be seen that each flower is fixed closely to a general stem; and that the lowest flowers have opened before those situated at the upper end. This arrangement of the flowers is called a *Spike*.

The flowers of the Mignionette, red and black Currant (f. 2.), will be found to have each a short stalk (*s*.) below it, by which it is connected to the general stem. This form of inflorescence is called a *Raceme*.

The flowers of the Sweet William are each placed on a stalk upon a common stem, but the lowermost have the longest stalks, by which arrangement all

Pl. 5.



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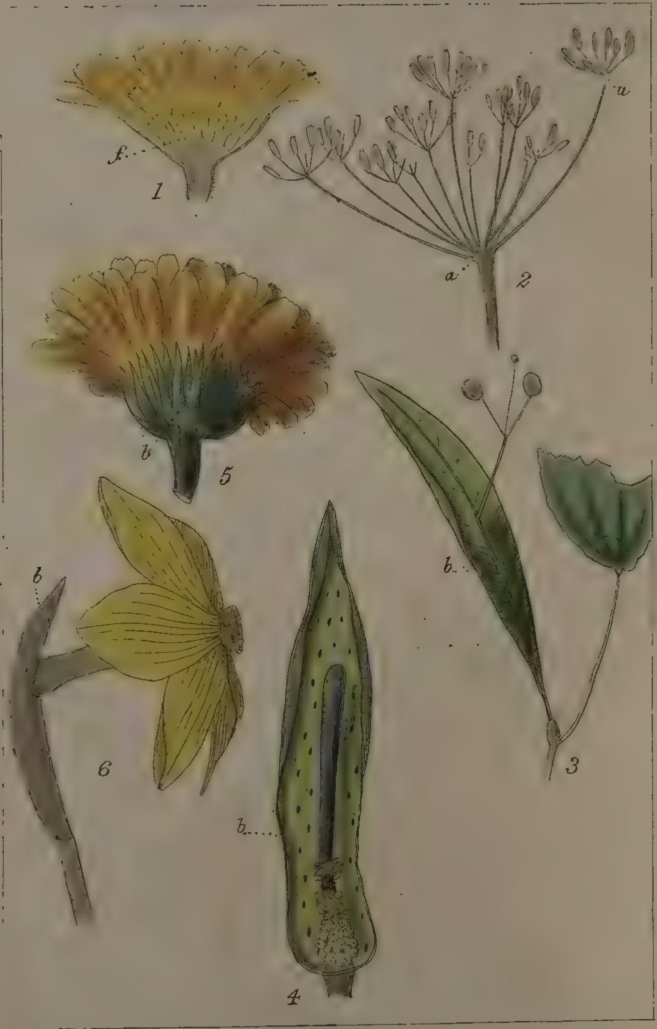
Pl. 6.



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the flowers are brought to the same level, so as to resemble a bunch or nosegay of flowers; in this instance the inflorescence is termed a *Corymb*; f. 3. is a kind of Cherry in which the flowers take this arrangement on a small scale.

If, however, each flower-stalk becomes divided into two or three branches, and so be made to bear two or three flowers, the arrangement will then resemble that of the Oats (f. 4.), or of the Lilac and Privet: which form of inflorescence is called a *Panicle.*

The flowers of the Elder are arranged somewhat after the same manner, but the stalks are short, so as to bring the flowers nearly on a level. This is called a *Cyme* (f. 5.).

On examining a Marigold (pl. 6. f. 1. *f.*), Dandelion, Sunflower, or Daisy, it will be seen that all the flowers are closely packed upon a small projecting surface, (which in the Daisy is very prominent), without any kind of stalk to support them; this kind of inflorescence is termed a *Capitulum*, which means a head of flowers.

The flowers of the Ivy, or Parsley (f. 2.), are placed upon stalks of nearly equal length, which are then collected together on the end of one stalk (f. 2. *a.*), and is termed an *Umbel.* This form of inflorescence is well seen in the Carrot, Parsley, Hemlock, &c. but in these instances it will be found that the whole collection of flowers, resembling an umbrella in its form, is made up of a number of flowers, first of all arranged as a simple umbel (f. 2. *u.*); and then each simple umbel is placed on a general stem and arranged so as to make what is termed a *compound* umbel.

BRACTS.

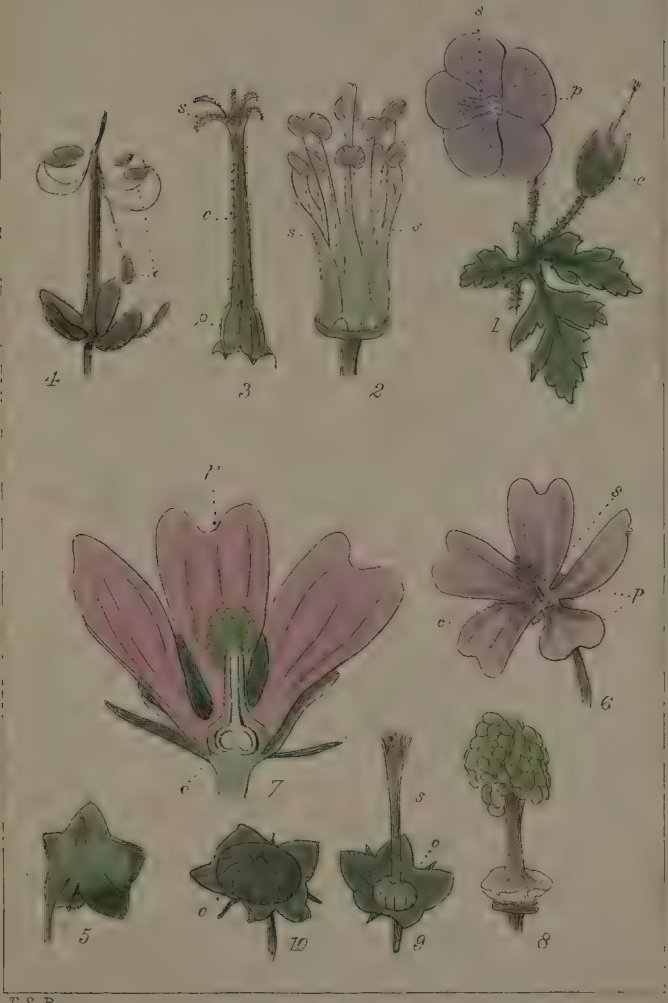
15. On examining a Lime Tree in bloom, the stalk supporting the flowers will be seen to rise out of a small leaf-like part, which is in fact a leaf diminished in size, and because so shortened and placed next the flowers is termed a *Bract* or short leaf of the flower. The large leaf which folds round the red berries of the Wake Robin or Cuckoo-pint (f. 4. *b.*), is a kind of bract. So also the withered leaf placed below the flower of the Jonquil, Narcissus, (f. 6. *b.*), or Daffodil, is a bract. In the Dandelion, Daisy, and Marigold (f. 5. *b.*), all the little green leaves situated below the flowers, and forming a cup-like covering, are so many bracts, but when so arranged are termed an *Involucre.*

OF THE FLOWER.

16. The next part of a plant to be examined is the Flower, and that it may be well and readily understood, the following examples, which will be found to be easy of access, must be carefully studied.—

a. On looking at a flower of a Wild Geranium, (a garden one will do tolerably well, if carefully compared with the figure in plate 7.), five small green leaves (f. 1. *c.*) covered with fine hairs will be seen just below the part called the *flower* or *blossom*. These together form what is called the *flower-cup*, and the term *Calyx* is also applied to this part. Within this flower-cup will be seen five large coloured leaves (*p*), (white, scarlet, &c. according to the kind of Geranium examined), which spread out into a broad flower, these together compose the *Corolla*, and the five divisions are termed

Pl. 7.



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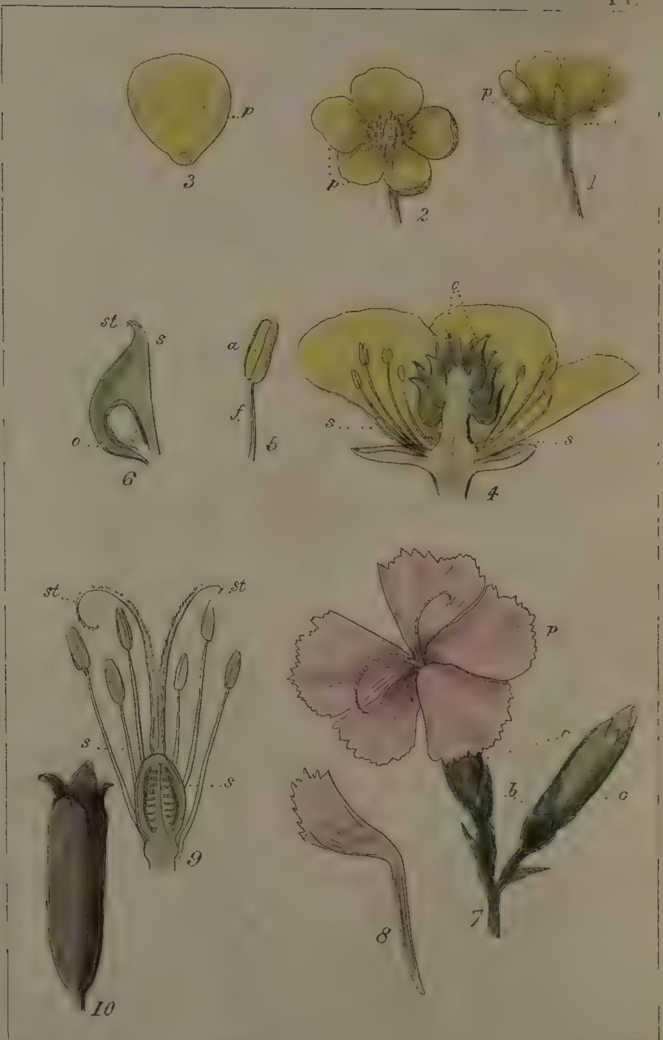
the *Petals* of the flower. It must be remembered that whenever the term *flower* is used in Botany, it means every part which is within the calyx and the calyx as well, and not merely the *blossom* or coloured part. Within the corolla may be seen ten small thread-like objects, which are wide at the base and narrow at the upper end, and tipped with a small red or reddish yellow coloured body (f. 1. *s.* 2. *s. s.*). In the garden Geranium the number of these will vary from seven to eight, and some will be without the coloured bodies; these are called *Stamens,* each stamen consisting of a thread-like part called the *filament,* and a small body on the very end of the filament, the *anther.* Remove the filaments with the point of a needle, or penknife in order to bring into view the central part (f. 3. *p.*) which will most likely be of a greenish colour and covered all over with clammy hairs, this is the *Pistil.* A careful examination will show that it consists of five rounded projections at the bottom with a column (*c.*) coming out of the upper part which ends in five points, each of the rounded bodies contains within it a young seed, and each is called an *Ovary,* or when ripe, a *Carpel.* The column is made up of five thread-like parts united together at the middle, but separated at the extremity into five points. The thread-like parts are called the *Styles,* and the five ends or points are termed *Stigmas.* When the plant has ripened its seeds, the five ovaries will separate from each other and roll up towards the end of the column as represented at f. 4. *o.* by which contrivance the seeds can be shed out of the ovaries by an opening in each.

b. The flower of the common or large Mallow is a good example for study.—Just below where the stalk expands into the base of the flower will be found three little triangular leaves (f. 5. *b.*), which are the *bracts*, or short leaves of the flower; above these is a cup-shaped part consisting of five portions united together as far as the middle, and is called the *Calyx* (f. 5. *c.*). Within this cup or calyx, are five large rose coloured or purple striped leaves termed the *petals* (f. 6 and 7. *p.*), each is somewhat triangular, with a notch at the broad or upper end. In the centre will be seen a column (f. 6. *s.* and 8.), divided at its upper end into a number of thread-like parts, each ending in a rounded or kidney-shaped body. The column consists of a number of thread-like parts called *filaments*, united below, but free above, each surmounted by an *anther* or case, which bursts and throws out a fine yellowish dust or powder. This column should be carefully removed with the petals, in order to bring into view a central part which is contained within or under it (f. 7. 9. *o.*), which will be found to consist of a flattened rounded green body below, with a column rising up from its centre, and which divides at its upper end into a number of thread-like portions. The green body below is called the *Pistil*, and is composed of ten or twelve little portions united, each part is called an *Ovary*, or *Carpel* when ripe (f. 10. *o.*); the column (*s.*) consists of as many thread-shaped parts as there are ends and are termed *styles*, and the point of each is called the *Stigma*; when the Pistil ripens, the column readily falls off immediately above the ovaries, which will then be found to be much

Pl.



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increased in size, and readily separating into a number of dry parts each containing a seed.

c. In the common Buttercup (pl. 8. f. 1.), where the flower joins the stalk upon which it is placed, will be found five small green leaf-like parts (*c*.), these compose the flower-cup or *Calyx*. Within these are five shining yellow leaves called the *Petals* (f. 1, 2, and 3. *p*.). The calyx and petals may be made to fall off by pressing them outwards with the point of a needle, &c. when the other parts of the flower will be more visible, viz. a great number of thread-like parts of a yellow colour (f. 4. *s*.), called *Stamens;* each stamen (f. 5.) consisting of a narrow portion below, termed the *filament* (*f*.), and an upper part or case called the *anther* (*a*.); many of these will be found covered with a yellow powder which has escaped from the interior after they have burst. Let the stamens be pushed off from their places, that the remaining part may be fully seen (f. 4. *o*.). This will be seen to consist of several green bodies placed one above another and forming a cone; each by itself is called an *Ovary*, (or a *Carpel* when ripe), and contains an unripe seed. In order that these may be better seen, search should be made for some flower which has already thrown off its calyx and petals, in which these parts will be found to be grown much larger, and become more distinct; each carpel, on examining it with a common magnifying glass, will be seen to consist of a rounded green part (f. 4. *o*. 6. *o*.), becoming small and narrow above, where it ends in a hook which is curved outwards. The lower part is hollow and contains the seed, and is called the *Ovary*; the hook or curved part is the *Style* (*s.*) and the very tip or point which will be found to be of a different colour, is called the *Stigma* (*st.*).

d. In the *single* flowered Pink, just where the stalk supports the flower, will be found two or three small scale like leaves (pl. 8. f. 7. *b.*) placed opposite to each other; these are called *bracts.* Then comes a green tube ending in five small teeth (*c.*), this is the *Calyx* or flower-cup. Open this tube with the point of a needle and five coloured parts will be seen (f. 8.), each is somewhat wedged-shaped, the broad part gradually tapering down into a stalk-like portion, which is hidden in the tube of the calyx; these five parts are termed the *Petals* (f. 7. *p.*). On carefully removing the petals, ten thread-like bodies (f. 9. *s.*) will be seen taking their rise from below a green one in the centre; these are called the *Stamens.* The white thread-like part is termed the *filament,* and the case or box at the top, the *anther.* The central body, which is green, has two thread-like parts rising out of its top, which spread outwards as they ascend, and parting from each other, end in a fine point. The oval green part is called the *Pistil,* it consists of two ovaries; which contains a number of white unripe seeds, called *ovules.* The two thread-like parts are called the *Styles,* and the ends are termed *Stigmas:* if these are examined with a glass, they will be seen to be covered with short fine hairs. When the seeds have ripened, the pistil will assume the form of f. 10, which is the seed-case, open at the top to allow the seeds to escape.

17. From the foregoing examples it will be seen that

the flower *botanical*, consists of a number of different parts which are arranged in a certain order. First, there is a flower-cup, or *Calyx*: this may consist as in the Geranium and Buttercup of five leaf-like parts called *Sepals:* or, as in the Mallow they may be united half way up their sides and assume a more cup-like form: while, as in the Pink and Sweet William, the calyx may have its parts united almost to the end, and so form a complete tube. All these are different forms of calyx peculiar to these different flowers; but the chief thing to be remembered is, that the calyx is almost always green, and is the outermost of all the parts of the flower. Secondly, there exists in many flowers a coloured part or blossom, called the *Corolla*, which consists of five (or more or less according to the plant) portions called *petals*, forming another cup-shaped part within the calyx. Thirdly, within the corolla another portion of the flower is to be seen, which, generally speaking, is very numerous in its parts; this consists of the *Stamens*, which may vary in number from one to a hundred. Each stamen usually consists of a thread-like part below, which is white or coloured, and is called the *filament*; and of a box or case of an oval shape at the upper part; this case bursts and discharges a fine powder, usually of a yellow colour, called *pollen* The Stamens in the Mallow, have their filaments united so as to form a tube below, while they are free or separate above. Fourthly, there is another part in the flower which occupies the centre, and is called the *Pistil*; which may vary as much in its character as any other part of the flower. In the Geranium, the pistil consists of five parts, called *ovaries,* from which proceeds a column composed of five *styles,* ending in five points, the *stigmas.* So that each part consists of an *ovary,* which is a hollow organ, a *style,* or continuation of the ovary, and a *stigma* or end of the style. In the Mallow, the pistil is the central part composed of eight, ten, twelve parts or *ovaries,* from which the united *styles* arise, ending in as many *stigmas* as there are *ovaries* below in the pistil. In Crowsfoot or Buttercup, the pistil consists of several ovaries placed upon a conical elevation, and separate from each other. The following then are the principal parts of the flower:—

1st. The *Calyx* or *flower-cup;* its parts when separate are called *Sepals.*

2nd. The *Corolla,* which when divided, consists of parts called *Petals.*

3rd. The *Stamens,* of variable number, each composed of a *Filament,* or thread-like part supporting a box or case, called an *Anther,* which opens and discharges *pollen.*

4th. The *Pistil,* which consists of one or more *Carpels;* each carpel being composed of an *Ovary* or hollow part containing *Ovules* or unripe seeds, a *Style,* or narrow portion, and a *Stigma,* or fine end of the Style. The ovules, when examined with a glass, will be seen to be fixed by small short threads or cords to the parts from which they grow.

OF THE SEED.

18. At a former place (par. 2. 3.) the principal parts

of the Seed have been noticed; it now remains to make some comparisons between the structure of different seeds; for all seeds are not alike internally, any more than they resemble each other externally; and if only a few be compared together, a marked difference will be found between them.

Compare, for instance, the thick shell or testa of the common Bean with the thin brownish one of the Almond, which peals off so readily after it has been steeped in hot water, or can be scraped off with the edge of a knife. The hilum, which is situated at the pointed end, is scarcely visible; while in the Horse Chestnut, the hilum is the broad whitish mark upon the brown seed. Let a few comparisons now be made respecting the internal parts in these different seeds: first, on opening the seeds of a Bean, Pea, or Lupin, (which should be done after soaking in boiling water,) it will be seen that the heart, or more properly speaking the radicle and plumule, is curved and situated at one side (pl. i. f. 2. *r.*), while in the Almond (f. 5. *r.*), Apple, Pear, and Walnut, it is quite straight and placed at one end. The seed-lobes or cotyledons differ, not only in their form, but also in consistence, those of the Almond being oily, while in the Bean they are hard and mealy. In the Walnut, the seed is that part which is within the shell, and the yellow skin which is peeled off before the Walnut is eaten, is the Testa. The radicle is situated at one end, and the two cotyledons are curiously grooved and crumpled on the outside.

19. There is another peculiarity to be noticed in some seeds; for example, the seed of the Beet, or

Spinach, presents, on having its testa removed, a large whitish substance (f. 6. *a.*), surrounded by the embryo (*e.*), as the cotyledons and heart together, are called. See also f. 10. which represents the seed of the Barberry cut open; *a.* is a white mealy mass surrounding *e.* the embryo. Now in the Bean and Pea, the cotyledons are very thick, and contain a quantity of nutritive matter, intended to supply the young plant with nourishment while growing under ground, and before it can sustain itself by means of nourishment derived from the earth through its roots. This may be seen to be the case on examining the cotyledons of a Bean or Pea, as soon as the young plant has appeared above ground, when they will be found to be shrivelled up to some extent, and empty. The mealy mass in the Spinach and Beet, is termed *Albumen*: it is a store of similar nourishment for the embryo, which is small for its size. This Albumen forms a principal part of a grain of Wheat, and the Coffee grain, or Berry, as it is called, is entirely albumen or nutritive matter for the young plant, which was lodged in the groove on the face or flat side of the Coffee Berry, but has been lost during its preparation. The next subject, which is a grain of Wheat, presents on one side, a deep groove, and a whitish scar at one end, on the other (f. 7 *e.*): if cut across with a penknife, it will appear as a mass of meal or flour without any trace of a young plant in it; but if cut lengthways, beginning at the extremity without a scar, there will then be seen at the end where the scar exists (f. 8. *e.*), a small notch or cavity, in which will be found a yellow body, which is the *embryo,* or young plant, and if examined with a glass will present the appearance as represented at f. 8. *e.*

20. If a few grains are set to grow, and examined at different stages of their growth, the radicle and plumule will become apparent, and also the wheat will be found to possess but *one seed-lobe* or cotyledon; the whole of the substance which is outside the notch or cavity, being a large mass of Albumen. This is a remarkable kind of seed, the characters of which should be carefully noted, as it will be referred to at another time. F. 9. represents a grain of wheat beginning to grow; *c.* represents the cotyledon; *p.* the plumule; *r. r.* the radicles; and the dotted line round the whole, the mass of the Albumen.

21. To sum up then the differences in seeds:

1st. In the Bean and Almond, we find a kernel, consisting of the two cotyledons, and the germ of the plant (called the heart); while in the Beet and Spinach, and some other seeds, the kernel (viz. the cotyledons, and the germ together), is surrounded by a mass of meal or other substance, which is termed Albumen.

2nd. That some seeds are found to possess but *one* cotyledon, as in Wheat, Oat, Rice, Lily, &c.

OF THE ROOT.

22. When the Root first descends, it generally does so in the form of a principal or main root, called also a *tap-root,* as in the Carrot, and long Radish: it may afterwards divide or branch off into a number of fibres, as represented at pl. i. f. 4. It often happens

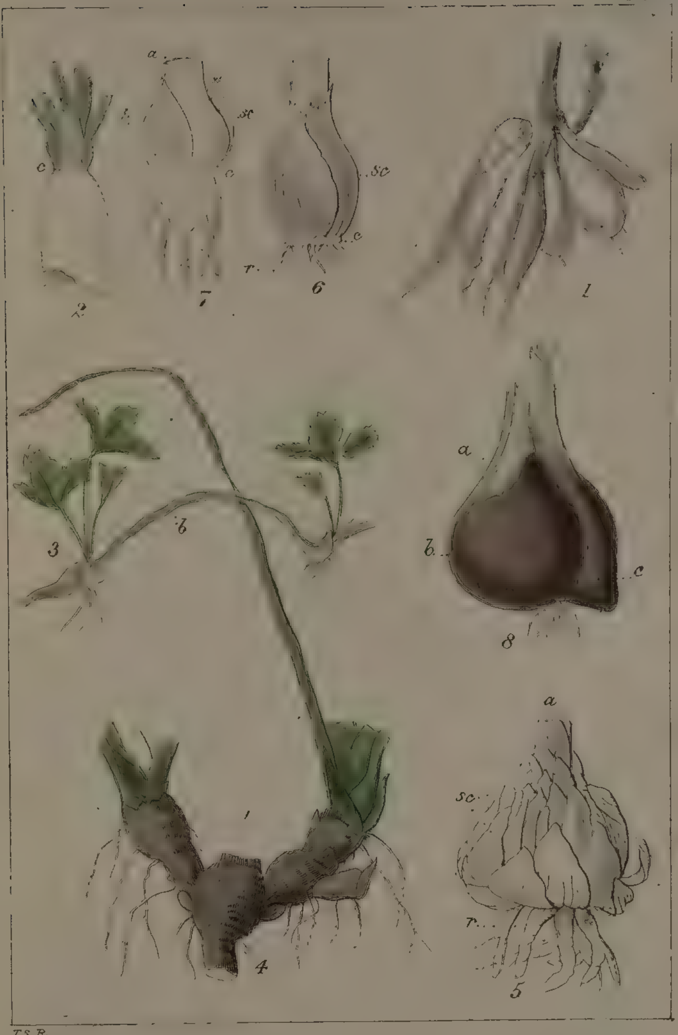
that this form of a principal, or tap-root, is lost from changes taking place in it, or some part of it, by growth; as in the Peony, Dahlia (pl. 9. f. 1.), which consists of a bundle of thickened roots; or, as in the meadow Saxifrage, in which the fibres of the root are thickened at intervals into round bodies, and the whole root assumes a *necklace-like* form. As a rule no leaves or buds are to be met with on roots, and when these are found upon parts of a plant growing under ground, such portions are considered to be *underground* stems rather than roots, as in the Potatoe, which is filled with what are termed eyes, or buds, and is considered to be a thickened underground stem furnished with buds, from which new plants can be produced. The principal use of the root is to give stability to the plant, and to supply it with nourishment by means of the numerous *fibrils* or root-lets, which are thrown out into the soil; or to lay up a store of nourishment for a future period; as in the Carrot, Dahlia, Peony, &c.

If a young plant, as a Radish for instance, be cut through *lengthways*, there will be seen a part which divides the stem from the root, which is considered to be the *vital* part of the plant, and it is termed the *collar*, *neck*, or *crown* (pl. 9. f. 2. *c*.).

OF THE STEM.

23. The Stem is that part of a plant which bears branches, leaves, and flowers, or only the latter: but there are some plants which are said to be *stemless*, by which is meant that the stem is so short as not to be apparent. Usually the stem grows upwards, but

Pl. 9.



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occasionally it lies along the ground, and sometimes produces a young plant at its extremity; as in the Strawberry (f. 3. *b.*), when it is called a *runner*, or sometimes an *offsett*, as in the Stone Crop. Sometimes as in the Iris (pl. 9 f. 4.), the stem every year produces branches on one side, and roots on the other, when it is termed a *root-stock*, or *rhizome, or root-like* stem.

24. There are some plants, as the Hyacinth, Onion, Lily, &c. which produce what are called Bulbs; these are commonly regarded as the roots of the several plants to which they belong; but such is not the case; for they are rather a kind of underground stem, from which true roots spring.

Pl. 9. f. 5. represents the Scaly Bulb of the white Lily, in which *a.* is the stem or axis cut across; *sc.* are the *scales*, or rudiments of leaves surrounding the stem; and *r.* the true roots. At f. 6. is seen the coated or Tunicated Bulb of the Leek, in the entire state; at *r.* the true roots are seen; at *c*, the collar, or part between the root and stem; at *sc.* the scales, or coats as they are called, which are leafy organs; and at *a.* is seen the axis or stem cut across: f. 7 is a lengthways cutting of the same, in which, besides the parts before mentioned, represented by the same letters, there is seen at *b.* a bud, or *clove*, which will take the place of the present year's bulb in the next summer, when the old one will die away. F. 8. is the Solid Bulb as it is termed, of the Meadow Saffron, in which may be seen the three conditions, through which the plant passes; at *a.* is seen the part or bud which flowered last year; at *b.* that which will flower this year; and at *c.* is the commencement of the one which will flower during the next year. In all these, the new buds feed on the nourishment which is deposited in the bulb, by the plant which has gone before.

OF THE STRUCTURE OF THE STEM.

25. When the young plant has risen above ground, it soon begins to take on all the forms which are peculiar to it as a plant; it lengthens, and gradually opens a few leaves; in process of time it throws out branches, if such is its nature; and at last expands its flowers, forms and ripens its seeds. But before all these latter parts of its structure can be produced, it has to perfect its stem as far as is necessary. Thus in the Lilac, which becomes a small tree, the first shoot is green and slender, this then buds some more new leaves, and commences at a later period to push out its branches; and in order that these branches may be able to have proper support, the stem grows with the whole plant, and at last attains a tolerable size. So that the part which is first formed, as the lower part of the stem, always keeps in advance of those parts which are formed at a later period.

26. This will be made clearer by making an examination of the structure of the stem, after the following manner.

If the examination is made during the winter season, the smaller branches and twigs of the plants referred to, will serve to show the structure. Take a young shoot of the Lilac in leaf, or of any other shrubby plant, as the Hedge-rose, Elder, &c. cut it across, and examine the appearance it presents; in the middle will be seen a mass of fine pith-like substance, which is surrounded by a greenish band. Next, examine a cutting of a piece of the stem, which is immediately below this young shoot, which part will have a brownish bark upon it, as it is a shoot of last year's growth: in this instance, the pith will be found to be smaller than in the shoot of this summer, or of the present year; there will be seen also a white *woody* ring, surrounding the pith, and outside this woody part, the thick covering or bark will be found to be green inside, and brown on the outside. A third cutting should then be made just below where this branch is given off from the tree; in this instance, the pith will be perhaps rather less, the woody substance will be found to present a wider space round the pith, and the whole thickness of the shoot will be greater; there will be also a thick layer of bark outside the woody part. In this manner, the examination may be carried on still further, and it will be seen that each part, as it is situated lower down, is thicker than that above it, as it has been formed a year or a season before, and if a smooth even cut is made across a stem, about half an inch in thickness, there will be seen just as many rings of wood surrounding the pith, as this part has been years growing. This will be better understood by referring to pl. 10. in which f. i. is half a *cross* cutting of a one year's stem of a maple magnified, which at *w*. represents a part near the centre, and in which a number of large round openings may be seen, which are vessels of the plant, cut across; this part will ultimately become the wood of the first year's growth: *b.* answers to that part which is nearest the outside of the stem, and is a mass of young green bark; at f. 2. the same stem is seen cut *lengthways*, and the same letters signify the same parts; f. 3. is a magnified view of a *cross*, or horizontal section of a maple stem, four years old; exhibiting at *p.* the pith; at 1. the wood, formed during the growth of the first year; at 2. that which was formed during the second; at 3. that during the third; at 4. that during the fourth year; at *b.* is seen the Bark, and between the bark and wood at *c.* a quantity of green matter, which will form the wood of the fifth year.

Each year a fresh layer of wood is added to every part of the tree, and as some parts are older than others, so these will be found to possess more wood; the wood deposited, is added outside that which is already formed; and the next year's wood will be added, or deposited outside that which is formed this year, and so on; each layer of wood being younger than that which has gone before. A fine line separates the different layers from each other, and the number of years the branch, or stem, has been growing, can be reckoned by counting the layers, or rings of wood which exist in it. At f. 4. is represented a *cross*, and *lengthways* cutting of a piece of wood, which has been seven years growing; at *p.* is seen the pith; 1. shows the wood of the first year's growth, surrounding the pith; 2. that of the second year, which will be seen to surround the wood of the first; 3. that of the third year, and so on; the bark in this figure has not been represented.

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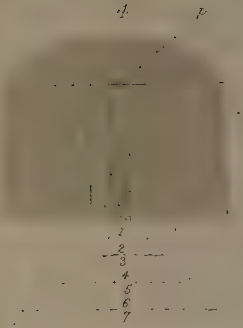

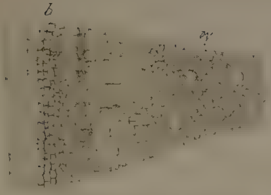

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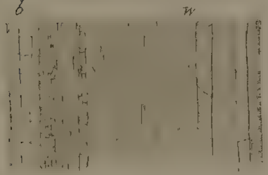

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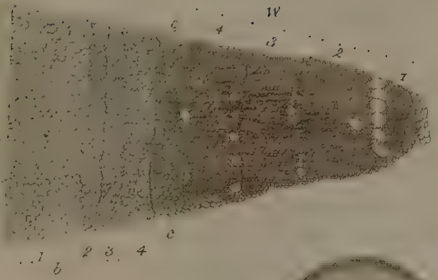

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27. In a moderate sized branch or stem of a Maple, or Plane, cut across very smoothly, may be seen, in the centre, as represented at f. 5. a small quantity of pith, surrounded by a number of rings or narrow layers of wood, each layer having been the growth of one year; these are surrounded by bark (*b.*). From the centre may be seen a number of fine lines, passing to the bark; these are intended to keep up a communication between the pith and the bark, and may be called *pith-rays.*

OF THE BARK.

28. The Bark grows in a different way to the wood; each year as the new wood is formed outside the old or last year's wood, some new bark is also formed along with it, so that in process of time, the older bark, or that which was formed at an early period, becomes removed further from the wood, against or upon which it was placed. That is to say, the wood of this year, has some bark lying upon it, but next year, a layer of new wood, and a layer of bark will grow up or be formed between it and its bark; and consequently the old bark will be pushed outwards, to make room for the new. This may be seen at f. 3. in which *b.* is the bark of as many years growth as there is wood; and at 1. is seen that bark which covered the wood of the first year, marked *w.* 1.; 2. that which belonged to the second year's wood, and so on; at *c.* is deposited what will form new wood, on *w.* 4. and new bark on *b.* 4. So that the wood and bark of the fourth, will be separated from each other.

29. The thicker the stem is, the thicker the bark generally, and the rougher and more cracked it becomes outside, as in the Elm; in which the bark remains without being cast, but cracks gradually; while in the Plane, it falls off in plates every year or two. Cork is the bark of a kind of oak; it is so soft that it does not crack, and consequently it remains on the tree, and consists of a number of layers, as may be seen on examining a bottle cork. F. 6. is a piece of a cork stem cut *across*, representing at *p.* the pith; *w.* the wood, which is in seven layers as seen marked off by fine dots, with the *pith rays* passing through them to the bark *b.* which is also composed of seven layers, the dark innermost layer, being the newest formed, while the outermost layers are cracked.

30. The stem of a Tree of some years growth, presents the following appearances: in the centre, very little if any pith will be seen; the wood is of a dark colour, and harder in the middle, while that which is nearer the bark, is white and soft (f. 5.); the reason is this, that the wood in the middle of the stem, is older than that which is outside it; and being fully formed and fit for use, is called the *heart-wood*, or *duramen*; while the lighter coloured portion is termed the *sap wood* or *alburnum*, and which in time will become of a darker colour, and harder texture.

31. The Bark varies in thickness according to the nature and age of the Tree; it is usually divided into two principal layers, one which is outermost and much cracked, and an inner layer called the *liber*, which lies upon the new wood; this inner bark in the Lime Tree,

Pl. II.

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yields what is called *bass*, of which coarse matting is made, for covering packages, &c.

OF THE LEAF AND ITS FORMS.

32. Leaves have already been noticed as divided into simple and compound (par. 11.).

Simple leaves, may vary from the *entire* form, or that in which the margins are perfect, as in the Lilac (pl. 4. f. 1.) to a very divided one, as in the Water Cress (pl. 3. f. 3.), or Parsley (pl. 2. f. 8.). The following are some of the principal forms of simple leaves; *lanceolate,* tapering at each end, as in the common Mezereon (pl. 11. f. 1.), and Pink: *oval,* as in the Dog-wood: *orbicular,* or *shield-like,* as in the Penny-leaf, or Cotyledon, and the garden Nasturtium (f. 2.): *sword-shaped,* as in the Iris: *angular,* as in the Upright Goosefoot (f. 3.): *spear-shaped,* as in the great Bindweed, or Convolvulus (f. 4.): *pinnatifid,* or deeply lobed, nearly if not quite to the midrib, as in the long prickly fruited Poppy (pl. 2. f. 7.): *palmipartite,* as in the Monkshood (pl. 11. f. 5.).

33. The leaf, when unprovided with a leaf-stalk, is said to be *sessile,* or sitting upon the stem: but sometimes the leaf seems to grow to the stem, as in the common Comfrey (f. 6.), in which it appears to run down the stem, when the leaf is said to be *decurrent.* Occasionally some leaves close round the stem at their base, when the stem appears to pass through them, as in the Honeysuckle, and Hare's Ear (f. 7.); such a leaf is said to be *perfoliate.*

34. Of Compound Leaves, the following are the

principal forms: *trifoliate* (pl. 3. f. 4.), as in the Clover and Trefoil, in which the petiole bears three leaflets: *pinnate*, as in the Bitter Vetch (pl. 12. f. 1.): *unequally pinnate*, as in the common Rose (pl. 3. f. 1.), Mountain Ash, Walnut, and False Acacia (f. 5.); as there is a single leaflet at the end of the leaf, which is not the case in the Bitter Vetch: *bipinnate*, in which the petiole supports a number of other petioles, each bearing its leaflets, as seen in pl. 12. f. 2.; found in some true Acacias.

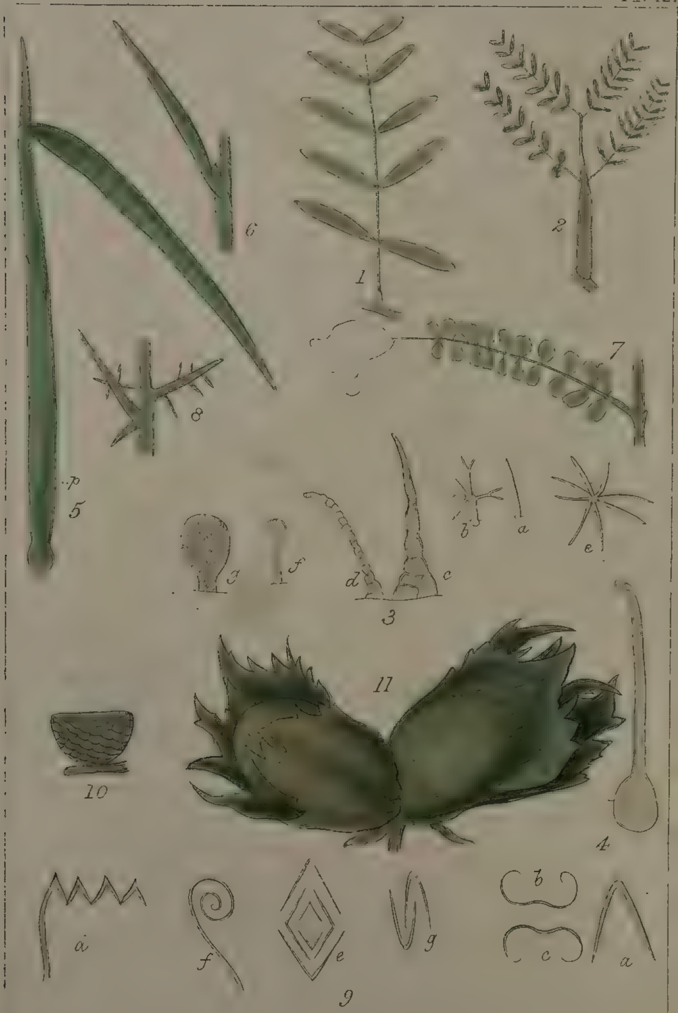
List of Plants with Simple Leaves: Elm, serrated; Lime, ditto; Plaintain, and Hyacinth, lanceolate; Oak, Hàwthorn, Plane, lobed; Dandelion, runcinate, a lobed leaf, the teeth pointing to the leaf-stalk, or base; Water Cress, pinnatified; Monkshood, palmipartite, or divided like the fingers of a hand.

Compound Leaves; Trefoil, and Wood Sorrel, trifoliate; Bitter Vetch, pinnate; Mountain Ash, Walnut, Rose, Jasmine, Robinia, or False Acacia, Bladder Senna, pinnate; the orange leaf is supposed to be a pinnate leaf, without the side leaflets being produced. In the Lupin is seen a leaf which is called a *fingered*, or *digitate* leaf, and bears some resemblance to the Monkshood, which is a simple leaf; so, also, the leaf of the Horse Chesnut is considered to be a compound leaf, of the same kind as that of the Lupin.

OF HAIRS, PRICKLES, GLANDS, ETC.

35. Some Leaves are quite smooth, and polished, as those of the Bay Laurel, Aucuba, Camellia; others are covered with fine hairs; these hairs when viewed

Pl. 12.



with a glass, are found to be formed in different ways; sometimes they consist only of a single cavity, or cell (pl. 12. f. 3 *a. b.*); while others are made up of two or three cavities or cells, joined end to end (f. 3 *c. d.*). In the Mallow, or Hollyhock, several hairs are placed together, round a common point or centre, so as to have the appearance of a star (f. 3. *e.*). In the common Nettle the hair is a single tube, with a swelling below where it joins the leaf (f. 4.); the tube contains an irritating fluid, which causes the burning sensation called *stinging* by a nettle; the point of the hair breaks off in the skin, and the fluid is discharged, so that there is a double cause for the pain produced.

36. Some Leaves, as those of the Sweet Briar, are furnished with what are called *glands,* these are small round bodies placed on a short stem or stalk, and contain a scented fluid (f. 3. *g.*); in other plants glands are placed either upon the surface of the leaf without any stalk; or, as in the Orange, and Myrtle, they are in the leaf itself, and may be seen by holding it up to the light, when they will appear as fine transparent dots

On the Leaves and Stem of the Rose, Sweet Briar, and other plants, are found what are commonly and wrongly called thorns; they are properly speaking prickles (pl. 3. f. 1. *p.*), and can be pulled off as they are merely fixed to the surface on which they are placed: they appear to be hairs in a thickened, and hardened state.

The true thorn is to be seen in the Sloe Tree (pl. 4. f. 4.); this is, in reality, a branch which bears only leaves when fully cultivated; and is considered to be a branch suppressed from some cause.

OF THE CHANGES WHICH THE DIFFERENT PARTS OF THE LEAF UNDERGO.

37. It has been stated (par. 7.) that a leaf is usually composed of a *petiole,* or *leaf-stalk,* and that in the leaves of some plants there are appendages called *stipules* (par. 9.); these different parts are variously modified or changed in some plants; and of these the following are examples.

The petiole in the generality of plants will be found to be jointed to the stem of the plant, as in the Oak, Elm, Lime, Plane, Lilac, &c. so that in falling off, a mark or scar is left on that part of the stem to which it has been fixed. The petiole is absent in the leaves of some plants; as in the Pink, Sweet William, Snapdragon, &c. (pl. 2. f. 3.); but in others, the petiole becomes widened where it reaches the stem, and instead of being fixed there, it surrounds it and passes down it like a sheath, and ends at a joint or swelling on the stem. This kind of petiole is seen in any Grass, Oat, Wheat, (pl. 12. f. 5. *p.* f. 6.), Barley, &c. and is called a *sheathing* petiole.

38. In the Compound Leaf of the Pea, and Vetch (pl. 12. f. 7.), the upper leaflets, or those towards the apex of the leaf, will be found changed into what are termed *tendrils*; by these the plant is enabled to lay hold of neighbouring objects, and support itself in the air. In the Furze (pl. 12. f. 8.), the leaflets are changed into thorn-like parts, which give the plant a

leaf-less appearance, and render the flowers so difficult to pluck off.

39. With regard to the Stipules, these parts of the leaf are frequently absent, as in the Lilac, Pink, &c. while in the Rose Tree (pl. 3. f. 1. *st.*), they are large and united by one side to the lower end of the petiole: they are large, and slashed or lobed in the Heartsease (pl. 2. f. 4. *st.*), and are often mistaken for the lamina or blade itself, which however is narrow, and has a short petiole. In the Tart Rhubarb they are united so as to form a tube or sheath, which surrounds the stem, just above the part where the petiole joins it. In the Robinia (pl. 3. f. 5. *st.*), or False Acacia, the two short thorns placed at the bottom of the petiole, are the stipules of the leaf, changed into thorn-like parts; and there are some Acacias which have the petioles so large that they resemble leaves, while the leaflets are often absent.

VERNATION, OR THE MANNER IN WHICH LEAVES ARE FOLDED UP IN THE BUD.

40. If leaves are examined at a very early period of their existence, namely, when they are just beginning to open in the bud, they will be found to be folded up in different ways: this is called *vernation*. The following are the usual forms; and in examining, the bud should be cut across, in order to show how the leaves are folded. In the Rose Tree, the leaflets will be found to be folded lengthways, one half upon the other; this is called *conduplicate* vernation (pl. 12. f. 9. *a.*), the margins of the leaf being folded together. In the

Rosemary and Willow, the edges of the leaf are rolled back, *revolute* (*b*.); in the Violet and Apple, the margins are rolled *inwards*, or the reverse of the former: this mode is termed *involute* (*c*.); in the Vine and Maple, the leaf is folded lengthways into plaits; the *plicate* vernation (*d*.); in the Lilac, the leaves cover or lap over each other, so that an outer leaf overlaps the edges of two inner ones: this is called *imbricate* (*e*.); in the Sundews and Ferns, the apex of the leaf is rolled inwards and downwards towards the petiole in the form of a *crosier*: the *circinnate* vernation (*f*.). When two conduplicate leaves infold each other, this is termed the *obvolute* vernation (*g*.).

41. Of the Bract, or Bractea, or shortened leaf, mention has been made at par. 15; the following are some modifications of the same. In the Jonquill and Narcissus, the bract is seen resembling a small withered leaf, just below the flower; and in the Arum, or Cuckoo-pint, or Wake Robin (pl. 6. f. 4.), and Arum Lily of green houses, it is the large leafy part which encloses the flower or red berries: this part is white in the Arum Lily. When a bract thus encloses a number of flowers, it is called a *spathe*. The green leafy organ placed immediately below the flowers of the Lime Tree (pl. 6. f. 4. *b*.) is also a bractea. In the Mallow, or Hollyhock, the bracts are the little green leafy parts, situated immediately below the calyx, or flower-cup, and as they are three, four, or five in number to each flower, they are then called an *involucre*. Bracts like these are found in the Daisy, and Sunflower, and other plants resembling them; they are very numerous, and form

a cup round a number of flowers, and bear also the same name of involucre (pl. 6. f. 5. *b.*). On the cup of the Acorn, may be seen a number of scale-like points, these are so many bracts, which have united to form a hard cup, called a *cupule* (pl. 12. f. 10.). But in the Hazel Nut, and Filbert, they are much larger and leafy, and hold the nut inside them (f. 11.). In the Beech and Spanish Chesnut, the bracts form the hardened spiny covering of the fruit.

OF THE CALYX.

42. The Calyx is the outermost of four sets of organs which compose a flower; it may consist of two or more small green leafy parts, placed in a circle below the rest of the flower, as in the Wallflower, Buttercup, Pimpernel (pl. 13. f. 1.). When thus constituted, these divisions of the calyx are termed *sepals*; and the calyx is described as consisting of two, three, four, five, &c. sepals; the usual term applied to it is, that it is a *polysepalous*, or a calyx of *many sepals.* But the calyx is in many instances composed of a like number of parts, which are united together so as to form a cup, or tube, in which the rest of the flower is contained. Thus, in the Pink (f. 2.), Primrose (f. 3.), Cowslip, &c. the calyx is a tube with five angular teeth at the top, which indicate the number of sepals or parts of which it is composed, the union of these parts not having extended to the points. Such a calyx is termed a *gamosepalous* calyx, or a calyx with the *sepals united.* Hence the calyx will be found to differ very much in its form, &c. according as its divisions or

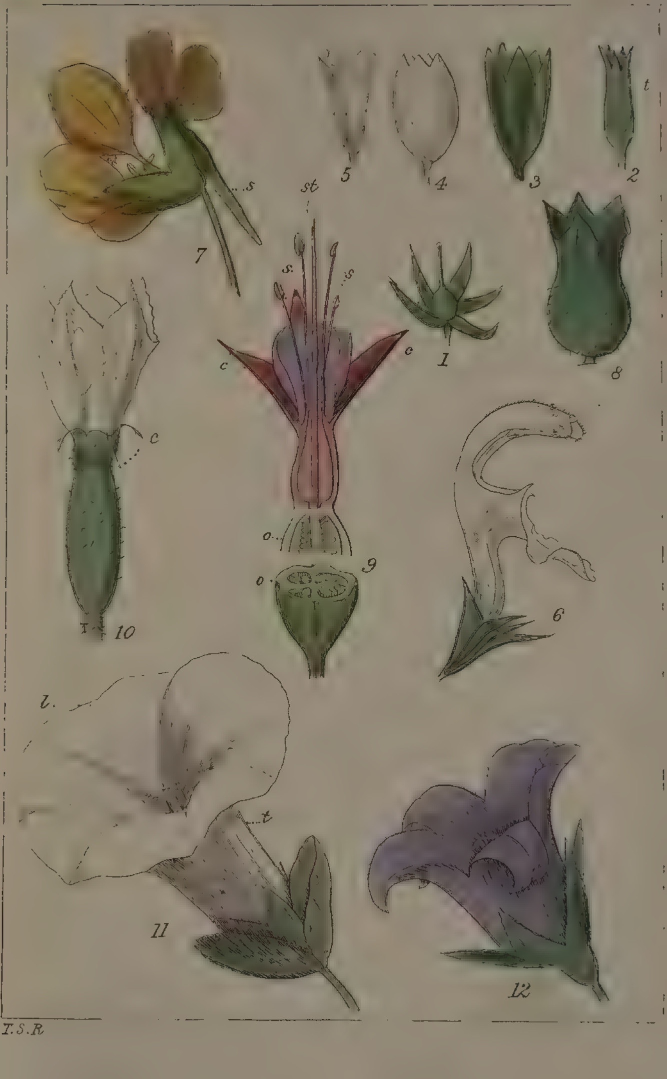
sepals are more or less completely united. That portion of a calyx with united sepals which is below the teeth, or divisions, is called the *tube* of the calyx (f. 2. *t*.). If the divisions are large, they are called the *limb* of the calyx, but if they are small, then they are termed *teeth*.

43. The principal forms of the calyx are these: in the Pink, and Sweet William, the calyx is *tubular* (f. 2.); in the Primrose, and Cowslip (f. 3.), it is tubular, but also *angular*: the calyx is called *ventricose* or *inflated*, as in the Catchfly (f. 4.), in which it is narrow at the upper part, while the lower or middle tubular portion is much distended. The calyx is *bell-shaped*, when it gradually becomes wider from below upwards, as in the Thrift (f. 5.). In the Sage it is two lipped; its divisions resembling an upper and a lower lip. In the garden Nasturtium it is said to be *spurred*, as one of the sepals is prolonged downwards into a tube (f. 7. *s*.).

44. When a gamosepalous calyx has no teeth or divisions, it is called *entire*; when the margin is slightly divided it is said to be *toothed*, as in the Lilac, Pink, &c. when these divisions reach as far as the middle, the calyx is said to be *cleft*, two, three, or four cleft, &c. according to the number, as in the Henbane (f. 8.). But when the divisions are carried nearly to the base it is termed a *partite* calyx, as in the Foxglove.

45. If the parts of the calyx, as in the Pink, Primrose, &c. are equal in size, it is called a *regular* calyx; but if as in the garden Nasturtium (f. 7.), its segments or parts differ in size or form, it is then termed an *irregular* calyx.

Pl. 13.



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46. There is another point of importance with respect to the calyx, which must be understood, and which will be referred to again; if the flower of a Mallow, Hollyhock, Wallflower, Buttercup, Primrose, Pink, &c. be carefully examined, it will be seen that all the parts of the flower, as the Corolla, Stamens, and Pistil, are quite separate from the calyx, although they are more or less contained in it. But in the flowers of the Myrtle, Campanula, Fuschia (pl. 13. f. 9.), Carrot (pl. 14. f. 6.), Currant, Gooseberry, Melon, Cucumber (pl. 13. f. 10.), and Evening Primrose, the calyx (*c.*) will be found to be united to the pistil, and the teeth or lobes of the calyx only remain separate from and above it. In these cases the calyx is said to *adhere* to the pistil, or to be a *superior* calyx: but in the former, it is said to be *free*, or an *inferior* calyx.

The proper way of examining the character of the *adherent* or *superior* calyx, is to cut the flower in two in a perpendicular direction down to the stalk, as represented in pl. 13. f. 9. of the Fuschia, when the actual position of the calyx with reference to the pistil will be well seen.

OF THE COROLLA.

47. The term Corolla is a general one used to express the coloured portion of the flower, or *blossom,* whatever may be the number of its parts. The divisions of the corolla are termed *petals,* and these may vary in number in different plants, as in the Buttercup, Pink, Wallflower; such corollas are termed *polypetalous,* or a corolla of *many petals.* The corolla may consist of

of one piece, as in the Convolvulus (pl. 13. f. 11.), Foxglove, Snapdragon, Campanula (f. 12.), Primrose, when it is called a *gamopetalous* corolla, or a corolla with *united petals.* A petal usually consists of a short stalk called the *claw*, and the broad part the *limb*, as in the Pink, Sweet William (pl. 14. f. 1. *c.* claw, *l.* limb).

48. In the *gamopetalous*, or *monopetalous* (petals united into one) corolla, the lower portion, that formed by the union of the claws of the petals, is called the *tube* of the corolla (pl. 13. f. 11. *t.*), and the upper expanded part (*l*) is termed the *limb*; where the tube and the limb join, is the *throat* of the corolla.

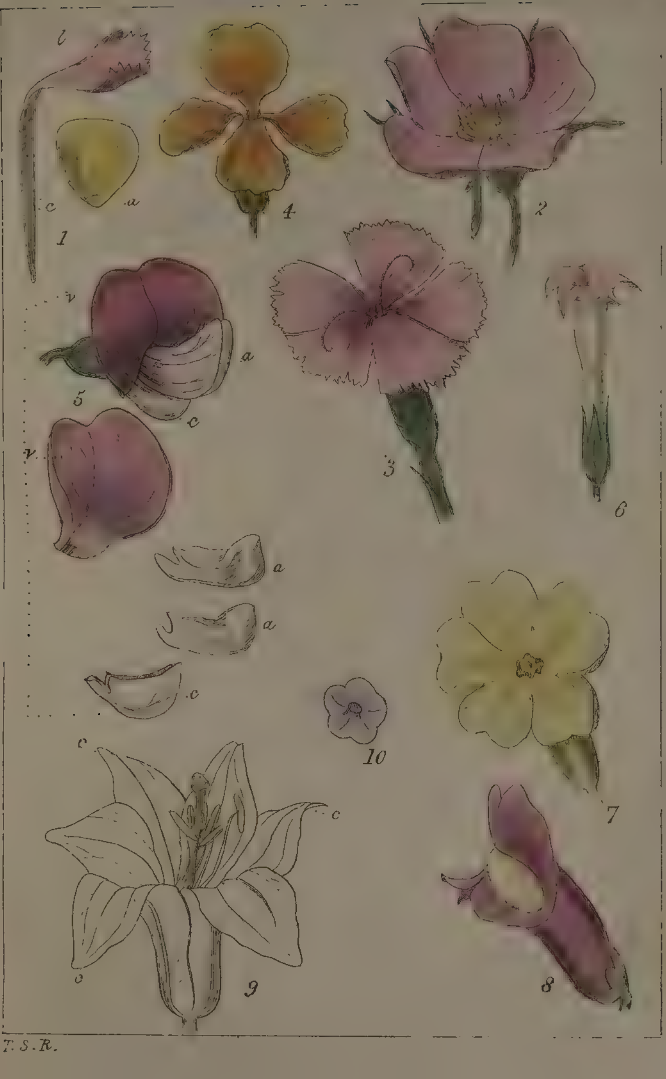
OF THE FORMS OF THE COROLLA.

49. When the petals are of equal size, it is said to be a *regular* corolla; but if the petals vary in size, it is then called an *irregular* corolla.

Of the regular polypetalous corolla, the following are the principal forms: the *Roselike*, or *Rosaceous* corolla, usually consisting of five petals, which spread widely in the form of a basin, and have a short claw (pl. 14. f. 2.). The *Pink*, or *Clove-like*, *Caryophyllaceous* corolla, in which the petals are five, and have long claws, which, without uniting, form a kind of tube, at the upper part of which, the *limb* of the petal spreads out, as in the Pink and Sweet William (pl. 14. f. 3.). The *Cruciform*, or *cross-like* corolla is seen in the single Wallflower, Stock, Cabbage, &c. it consists of four petals only, which are placed two and two opposite each other, in the form of a Maltese cross (f. 4.).

50. The *irregular* polypetalous corolla, is seen in

Pl. 14



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the Pea (f. 5.), Bean, Lupin, and others of the same family.—

It consists of five petals, which vary in size and shape, one petal is usually larger than the rest, and is called the *standard*, or *vexillum* (*v.*); two others are placed opposite to this, which are narrower and smaller, and are called the *wings* or *alæ* (*a.*), and two others will be found within the wings, partly united together, so as to resemble a boat; these two are called together the *keel*, or *carina* (*c.*). This form of corolla is sometimes called the *Papilionaceous*, or *Butterfly-shaped* corolla.

51. The *monopetalous*, or gamopetalous corolla, (or petals united), is also *regular* or *irregular* according as it is composed of parts which are equal or unequal.

The monopetalous *regular* corolla may be *bellshaped*, or *campanulate*, as in the Campanula (pl. 13. f. 12.).

Funnel-shaped, or *infundibuliform*, as in the Tobacco (pl. 14. f. 6.); in which the tube is narrower and longer than in the former kind,

Salvershaped or *hypocrateriform*, as in the Primrose, in which there is a tube, and the limb is spread out flat, like a salver (pl. 14. f. 7.).

The *wheel-shaped* or *rotate* corolla, differs in having a very short tube (f. 10.).

52. Of the monopetalous *irregular* corolla, the two principal forms are the *ringent*, or *labiate*, or two lipped corolla; as in the dead Nettle (pl. 13. f. 6.), Sage, in which the corolla is divided in two principal lobes, called *lips*; and *personate* or *mask-like* corolla as seen in the Snapdragon (pl. 14. f. 8.); this differs from

the former in having the lips closely pressed together.

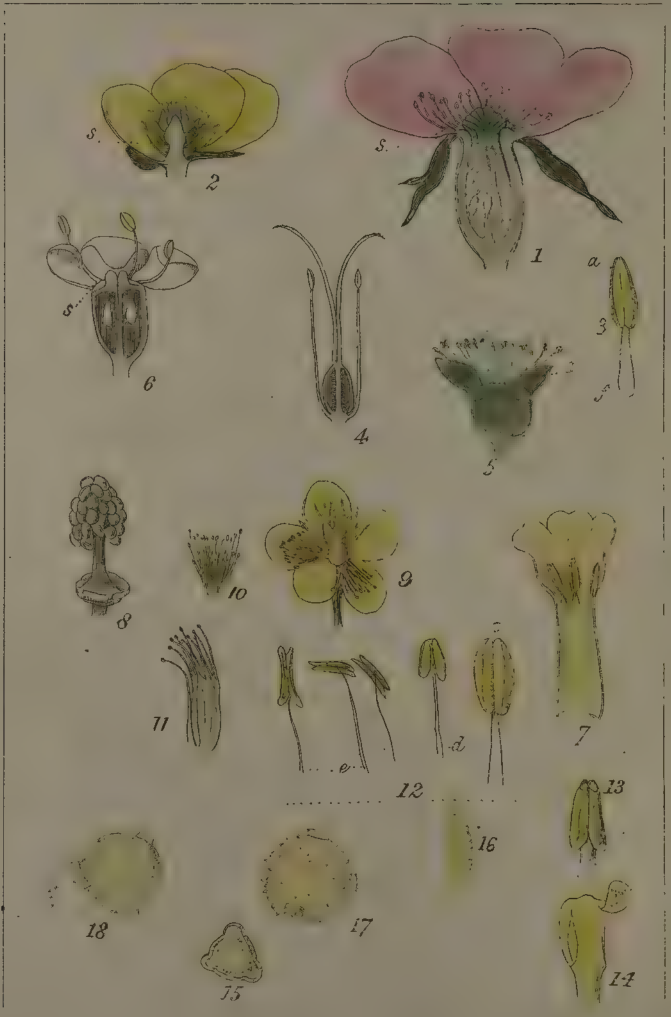
53. In some flowers as in the Tulip, Hyacinth, Onion, Lily, &c. it is difficult to distinguish between a calyx and corolla, or rather there appears to be nothing but a corolla: if the flower of a Lily (pl. 14. f. 9.), is examined, it will be seen that out of the six petal like parts, three (*c.*) are placed outside three inner ones, and that the backs of the outermost are slightly tinted with green when the flower is opening; and these only can be seen in the bud, while the others are contained within them; these outer parts may be considered as the calyx, but on account of the difficulty of stating exactly what part is calyx, and what corolla in some flowers, the term *Perianth* is applied to such, to signify that the calyx and corolla cannot be distinguished from each other.

54. The corolla, as a whole, is in some flowers fixed to that part of the stalk which is immediately above the calyx, as seen in the Buttercup (pl. 15. f. 2.), while the petals of the Rose (f. 1.), Bramble, Pear, Apple, and Hawthorn, will be found to be placed on the calyx, which cannot be removed without taking the petals along with it. In the Campanula, Fuschia (pl. 13. 9.), and Carrot, the corolla appears to arise from the upper part of the pistil. This subject will be more fully treated of under the position of stamens in the flower.

OF THE STAMENS.

55. The Stamens form the third set of organs of a *complete* flower; for the flower, considered botanically, may have neither calyx or corolla, and may consist of

Pl 15



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either calyx, stamens, and pistils; or stamens and pistils only.

The stamen (pl. 15. f. 3.), generally consists of a thread-like part, the *filament* (*f.*), supporting on its end a coloured body or case, the *anther* (*a*), or pollen-case: the anther is occasionally present without the filament.

OF THE POSITION OF STAMENS IN THE FLOWER.

56. On comparing different flowers together, it will be seen that the stamens are not always placed on the same part. This difference of position is important in Botany, and therefore should be attended to by the student.

57. The stamens in the Buttercup (pl. 15. f. 2. *s.*), Wallflower, Pink (f. 4. *s.*), Sweet William, Tulip, Lily, &c. will be seen to be fixed upon a part in the flower which is immediately below the pistil; that is, on a part of the stem which supports first, the calyx, then the corolla above, and then the stamens. This is termed the *insertion*, or *position* of the stamens, and as in the above examples, they are placed immediately *below the pistil*, and are free from the calyx or corolla, the insertion is said to be *hypogynous*.

58. But in the Rose (f. 1. *s.*), Cherry (f. 5. *s.*), Apple, Pear, Hawthorn, &c. the stamens are found to take their rise from the calyx, which, when torn off in pieces, will carry the stamens with them; in these flowers they are placed around the pistil, but not below it, and the term *perigynous* is applied to this mode of insertion.

59. In the Carrot (f. 6. *s.*), Campanula, Fuschia (pl. 13. f. 9. *s.s.*), and other flowers, the stamens appear to spring from the top of the pistil; but they are in reality placed on a calyx which is attached to it: in such the stamens are said to be *epigynous*, or inserted upon the pistil.

60. In the Sage, Lavender, Dead Nettle, Jasmin, Primrose (pl. 15. f. 7.), Convolvulus, Potato, Foxglove, &c. the stamens can be removed with the corolla, and they appear to be inserted into that organ; but they only adhere to it, and can be traced down to the base of the pistil.

61. The position of the corolla or petals will, by a general rule, be the same as that of the stamens; and as these are *hypogynous* in the Buttercup, &c. the petals also occupy the same relative position: and the same rule applies to the petals of the Rose, &c. in which the stamens being *perigynous*, the petals also are inserted on the same part. Sometimes the stamens are described as being placed upon the *calyx*, which is the same as the *perigynous* insertion.

62. The stamens are in many flowers quite *free*, that is, each filament stands independent of those next it, as in the Buttercup (pl. 15. f. 2), Rose, Cherry (f. 5.), Pink (f. 4.), &c. but in the Hollyhock, and Mallow (pl. 7. f. 6.), the filaments are united into a *tube* (pl. 15. f. 8.), and constitute one bundle or packet of stamens in the flower; the term *monodelphous*, or one *brotherhood* is applied to such a combination. In the St. John's Wort (pl. 15. f. 9.), three or five bundles of stamens may be seen, each consisting of several

stamens (f. 10.); in this example the term *polyadelphous*, or *many brotherhoods* is used.

The stamens in the Pea (f. 11.), are ten in number, and it will be found that nine are united into one packet, and one remains separate; this has the term *diadelphous*, or *two* brotherhoods applied to it.

63. The Anther (f. 3. *a.*) consists of two small hollow cases, placed side by side on the end of the filament, which appears to pass between them (f. 12. *c*) and is termed the *connective ;* and the anther is said to be *adnate*, united to the filament. Sometimes the filament supports the anther on its point, as in the Cherry (f. 12. *d.*), when it is called *innate*. In Grasses the anther is supported by its middle (*e*) from the end of the filament and is free enough to swing in the air; the anther is then said to be *versatile*, or *oscillating*.

64. In some flowers, as in the Hollyhock and Mallow, the anther is composed of but one case. In the Dandelion, Sunflower, Violet and Heartsease, the anthers are united together by their sides.

65. The cells or cavities of the anther open at some period, either by a slit, which is the usual way, or by means of a small hole or pore at the upper end, as in the flower of the Potato (f. 13.), and Heaths; or by means of a valve, or small portion of the side of the anther curling upwards like a lid (f. 14.); and by these means the pollen is discharged from its cases. The pollen is serviceable in fertilizing the ovules or germs of seeds contained in the ovary, and consequently a part falls upon the stigma for this end.

66. The pollen, viewed under a powerful glass,

presents various forms, but its shape is constant in plants of the same kind; thus in the Evening Primrose its shape is triangular (f. 15.), oval in a kind of Onion (f. 16.), globular in the Gourd (f. 17.), and Almond (f. 18.), in which it is represented as bursting.

OF THE PISTIL.

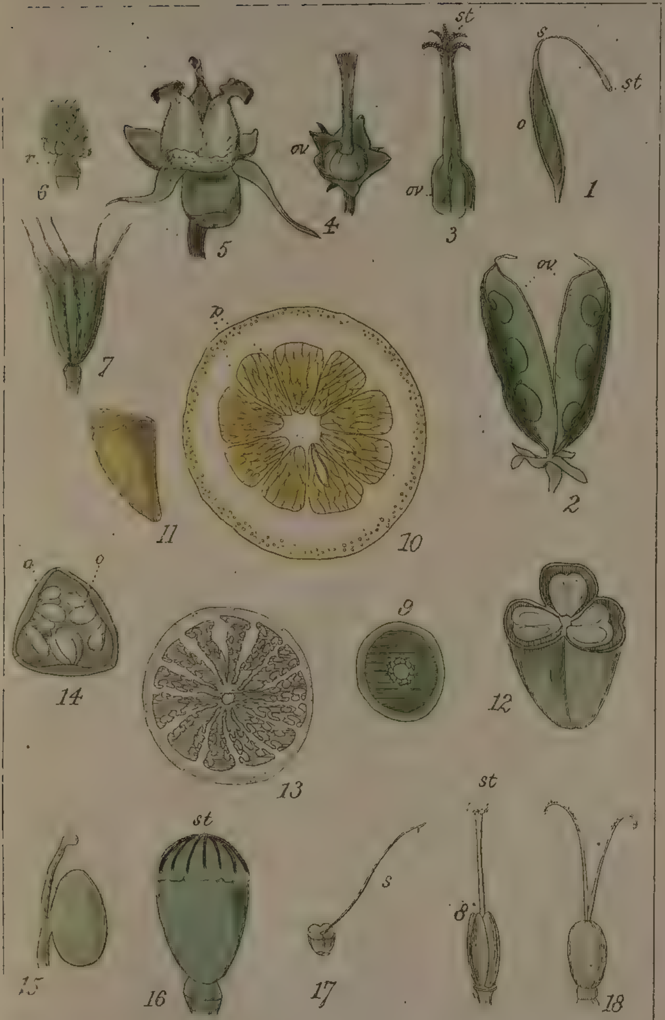
67. The pistil constitutes the central part or organ of the flower; it is either simple or compound, according as it is composed of one or more carpels.

68. The pistil consists of an ovary (pl. 16. f. 1. *o.*), or hollow organ, a style (*s.*) or the part continued upwards from the ovary, but which is not always present; and the stigma (*st.*), or moist end of the style. Figures 1 and 2 represent the young, or unripe pod of the Pea, which will serve as an example of a *simple* ovary: in it the young peas (f. 2. *ov.*) will be found arranged on one side of each half of the pod; and if compared with others, these *ovules* or unripe seeds will be found to be always placed on the same side or edge of the pod. The parts to which the ovules are fixed is called the *placenta,* or *receptacle* for the ovules; this part is present in all ovaries, but varies as to its position and form.

69. The ovary may be alone in the flower, as in the Pea, or there may be several ovaries in one flower, as in the Geranium (f. 3. *ov.*), and Mallow (f. 4. *ov.*), in which they are arranged in a circle round a centre.

These ovaries may be separate from each other, as in the Peony (f. 5.), Buttercup (f. 6.), Love in a Mist (f. 7.); or they may be united to each other by their

Pl. 16.



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sides, and appear as a single body, as in the Mallow (f. 4.), Lily (f. 8.), Evening Primrose, Foxglove, &c. but by cutting such a body across, it will be seen to be composed of a number of cells, separated by as many partitions, or *septa* as they are called; these partitions are the sides of the ovaries united: in many instances they may be separated into two layers, proving that each cell is composed of an ovary.

An Orange (f. 10.) cut across shows on a large scale the arrangement of several ovaries; in the middle is seen a white centre, with a number of partitions (*p*.) passing outwards to the rind or peel, and the pips or seeds will be found lodged at the narrow end of these divisions. (The pulp of the orange is peculiar to the fruit, and has nothing to do with the arrangement of the different parts.) When the peel is taken off, the soft bulk of the orange can be easily separated into portions varying from eight to ten; each portion is an ovary (f. 11.), (but when in a ripe state is called a *carpel*,) and is united by its sides to two others, forming altogether a *compound* ovary: the *placentas*, or seed-bearing parts are the narrow edges of these carpels, which occupy the centre of the fruit; the partitions in the cut orange appear to be single, but are, in fact, double, just as they are in other compound ovaries.

70. But partitions do not exist in every instance in which carpels are united together; as for example, in the Pink (f. 9.), Sweet William, and Primrose, in which it is supposed two or more ovaries have been united, but which have not produced their sides, and consequently no partitions are to be found in them.

In the young Poppy (f. 13.) may be seen a number of partitions which scarcely reach the centre, which in the full grown poppy head do not extend half way from the sides; showing that their increase has not kept pace with the growth of the walls of the ovaries.

The ovules in the Pink, &c. occupy the centre of the pistil, while in the Poppy they are placed upon the sides of the partitions (f. 13.).

In the Violet and Heartsease, there are three ovaries (f. 14.), but they do not form any partitions, and the ovules (*o.*) are fixed in three rows on the sides of this compound ovary.

71. When a great many ovaries exist in one flower, (as in the Buttercup, f. 6. &c.) they are arranged in a different way to those of the Orange, Geranium, or Mallow, &c. They are usually placed on a cone (*r.*) called a receptacle, and are arranged on it in a spiral manner; this receptacle is also called an elevated *axis*; it is in fact a continuation of the same part, as that on which the stamens, petals, and calyx of the flower are arranged.

72. Thus the ovaries may vary in number from one to twenty, or more, and they may, like the other parts of the flower, be separate, or combined into one body. The ovary or ovaries may be united or adhere to the calyx and other parts of the flower; and then the term *adherent* calyx, or *adherent* ovary is employed, to denote such a condition (par. 46.). This union of the calyx may extend to a part, or to the whole of the ovary, as in the Myrtle, Evening Primrose, and Fuschia (pl. 13. f. 9. *o.* ovary, *c.* calyx). Sometimes the calyx

is much increased in size at its tube, so as to enclose and shut in the ovaries, and yet not combine with them into one body; this is well seen in the fruit, or hip of the Dog Rose, and other Roses (pl. 15. f. 1.).

It is necessary therefore to examine carefully the real structure of an ovary, which appears to be inferior or adherent to the calyx; and in order to do so, the flower should be cut in a perpendicular direction, as represented in the figure referred to.

OF THE STYLE, AND STIGMA.

73. The Style usually takes its rise from the upper part of the ovary, but it may also arise from its base, as seen in pl. 16. f. 15. The styles of several ovaries may be separate from each other; as for example, in the Chickweed, Pink (f. 18.), Sweet William, &c. or they may be united, as in the Mallow (f. 4. *s.*), Geranium (f. 3. *s.*), Lavender, Sage (f. 17. *s.*), &c. In like manner the stigmas of several styles may be free, even when these last are united, as in the Geranium (f. 3. *st.*); or they may be united into one head, as in the Lily (f. 8. *st.*), Heath, Fuschia (pl. 13. f. 9. *st.*), &c.

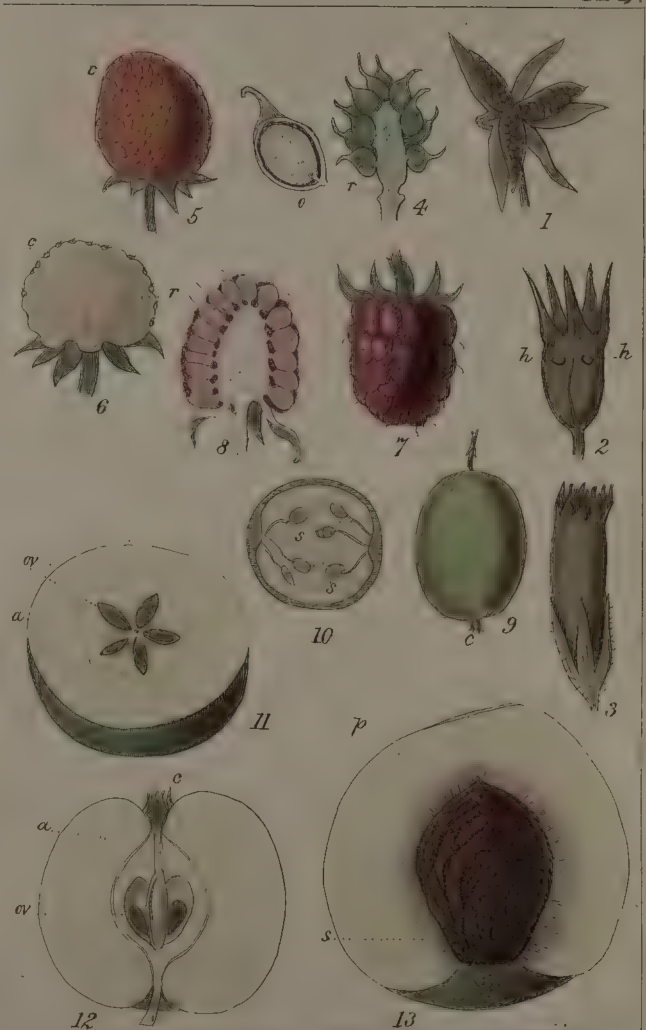
In the Poppy (pl. 16. f. 16.) the styles are absent, and the stigmas (*st.*) are seen in the form of hairy rays passing from the centre to the circumference of the top of the compound ovary.

OF THE FRUIT.

74. The Flower begins to undergo several changes as soon as the ovules have been fertilized in the ovary.

Usually all the other parts of the flower, as the calyx, petals, and stamens, together with the style, wither and fall off. Occasionally only some of these organs are removed, while those which remain are often subjected to change. The ovary itself frequently undergoes considerable changes; generally it enlarges, together with the ovules, which now begin to advance to the condition of seeds, while the ovary becomes the *seed vessel*, or *Fruit*. The term *Fruit* in Botany, has, like the word *flower*, a different meaning to that commonly applied to these two objects: the fruit in Botany implies an ovary arrived at maturity, and furnished with seeds. Thus, the term *fruit*, is applied to an Apple, which is eatable, and to the spiny cases of the Horse Chesnut, or Spanish Chesnut, neither of which are eaten, while the seeds of the latter are eatable when roasted; or it is applied to the Walnut, which in its green state is fit for pickling, but the part eaten when fully ripe is the seed; the shell or rind in this instance, being the *seed-case*, or *fruit*.

75. Besides the enlargement which the ovary undergoes, internal changes sometimes take place to such an extent, that it is scarcely possible to recognize the structure of the ovary in the fruit of the same plant. For instance, the ovary of the Pea, differs from the pod when fully ripe only in an increase of size, and the ovules likewise. So also with regard to the ovary of the Orange, and its ripe fruit. But the ovary of the Horse Chesnut and the fruit differ considerably, both externally as well as internally. This ovary will be found to contain three small cavities, and in each cavity



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two ovules fixed to the centre: but the ripe fruit contains but one cavity, and this cavity only one seed: these observations apply to a great many other fruits.

76. When the fruit has arrived at maturity, some provision is usually made for the escape of the seeds. In some plants, the fruit falls into regular pieces, as in the Horse Chesnut, and Violet (pl. 17. f. i.), so as to allow the seeds to fall out: in other plants, as in the Poppy, and Campanula (f. 2. *h.*), the fruit opens by small holes near the top; or entirely, as in the Chickweed (f. 3.); the pod of the Pea opens by two seams which are marked upon its edges, which are called the *sutures* of the carpel or ripe ovary,—sometimes only one suture of a carpel opens. This process of opening is termed the *dehiscence* or splitting of the fruit. In the Apple, Pear, Peach, &c. this process does not occur, and fruits like these are termed *indehiscent*, or not opening for the escape of the seeds. Such fruits generally lie on the ground until they have decayed, and then the seeds begin to grow.

77. It has been shown at par. 69, that the ovaries of a flower may be combined into a mass or body, as in the Orange, Lily, Mallow, Pink, Violet, Mignionette, &c. or they may be separate from each other, as in the Peony, Buttercup, &c. so in like manner the carpels or ripe ovaries of these several flowers, will be combined or separate from each other. Pl. 16. f. 12. shows the three carpels of the Lily (f. 8.) thus combined.

Fruits are arranged under different heads according to their structure.

78. The fruit of the Pea, Bean, or Lupin is a single ovary and is called a *legume*; while the fruit of the Apricot, Plum, or Cherry, which is also but one ripened ovary, and called a *drupe* (pl. 17. f. 13.), differs chiefly from the legume in the circumstance of not opening (*dehiscing*) at maturity, and of having the shell thickened partly into a pulp (*p.*), which occupies the outside, and a hard substance (*s.*) or stone, which lines the inside: these fruits resulting from a *single* ovary in each flower, are termed *simple*.

AGGREGATE FRUITS.

79. But when the ovaries are *simple,* (uncombined), and yet numerous in one flower, as in the Buttercup (pl. 17. f. 4.), the term *aggregate* fruit is applied. Thus in the Buttercup, a number of carpels are placed upon a *dry* receptacle (pl. 17. f. 4. *r.*); while in the Strawberry (f. 5. and 6.), the carpels are the small seed-like bodies (*c.*) placed upon the soft spongy mass (*r.*), which is eatable, and answers to the receptacle in a *fleshy* or enlarged state: while in the Blackberry, and Raspberry (f. 7. 8.), the carpels form a soft mass, which can be pulled off from a *white core* on which they are placed, and which is also a receptacle (*r.*) in a *dry* state. That the small bodies on the Strawberry, and the soft spongy ones in the Raspberry, are ripe ovaries, may be ascertained by examining them closely, or by means of a glass, when each will be found to possess a style, and to contain a minute seed: f. 7. shows a number of ovaries with styles, and f. 8. the same, seated on a white centre (*r.*), the receptacle.

80. When several ovaries are combined together and form one body, the fruit is said to be *compound.* The most familiar examples of this kind are seen in the Orange, Violet, Mignionette, Wallflower, Apple, Horse Chesnut, &c.

The following are the principal forms of the *compound fruit.*

81. The *Pome,* as in the Apple, and Pear, in which there are five carpels (f. 11. *ov.*), surrounded by a fleshy, or thick mass (*a.*), called *the apple,* or eatable portion; the ovaries form the *core,* or parchment-like part in the centre containing the pips or seeds; while the white mass outside, is the calyx thickened and united to the ovaries; which may be ascertained by examining the top of the Apple or Pear, where the teeth of the calyx will be found remaining in the form of a crown (*c.* f. 12.); and by watching the Pear, or Apple flower from the time when the fruit becomes *set* until it is ripe. At the period of the flower, the ovaries will be seen to be lodged in the calyx, which gradually enlarging at length unites with them.

82. The *Berry,* as the Currant, and Gooseberry, in which two or three ovaries are combined and united to the calyx, which crowns them with its teeth; the seeds will be found mixed with a pulpy juice, and fixed to the sides of the fruit by long cords; (f. 9. and 10. *c.* the crown or teeth of the calyx; *s.* the seeds).

The fruit also of the Gourd and Cucumber, closely resembles the Berry.

83. The *Capsule* consists of a number of *dry* combined carpels, which open at maturity: example,

Poppy, Chickweed (f. 3.), Pink (pl. 8. f. 10.), Corncockle.

84. The *Siliqua* is a kind of capsule, but consists of only two carpels, as in the Wallflower (pl. 18. f. 3.), Stock, Cabbage, Radish; the seeds are fixed to two placentas, or receptacles on the edges of the carpels.

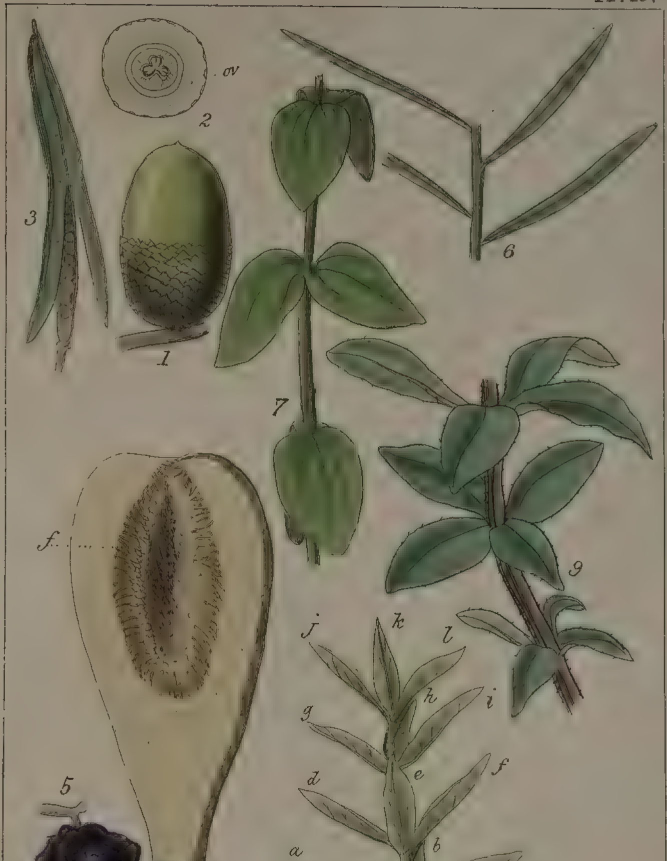
85. The *Acorn* (pl. 18. f. 1.), or *Nut* is a fruit which in the early state is composed of three ovaries (f. 2. *ov.*), each containing two ovules; but of which only one ovary arrives to maturity with one, or rarely two seeds in it: the whole is enclosed in an *involucre* or *cupule* (par. 41.), as in the Hazel, &c.

COLLECTIVE FRUITS.

86. There is another kind of fruit which is to be seen only in a very few examples in this country, and is called a *Collective Fruit*: as the Fig, Mulberry (pl. 18. f. 5.), and Pine Apple: these fruits consist of the calyx and ovaries of a great number of flowers combined into a solid mass. The Fig (pl. 18. f. 4.), when cut open will be found to *contain* the stamens and pistils of many flowers (*f.*), the thick eatable part being the axis or stem softened and enlarged at the expense of the former.

87. It now remains to take a general view of the nature of all the various organs which have been examined in succession, beginning with those of the seed, onwards to the ovary. It appears that a plant is composed of a root, or descending axis, and a stem or ascending axis, which last is furnished with appendages of various kinds, such as leaves, &c. and which

Pl. 18.



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are to be considered as so many modifications of one organ; viz. the leaf.

88. In the seed, the two seed-lobes or cotyledons, are to the heart or corculum, (which constitutes the stem and root of the future plant) two leaf-like organs; in some plants, as for example, the Lupin, &c. the seed-lobes rise out of the ground, and assume the colour and appearance of leaves.

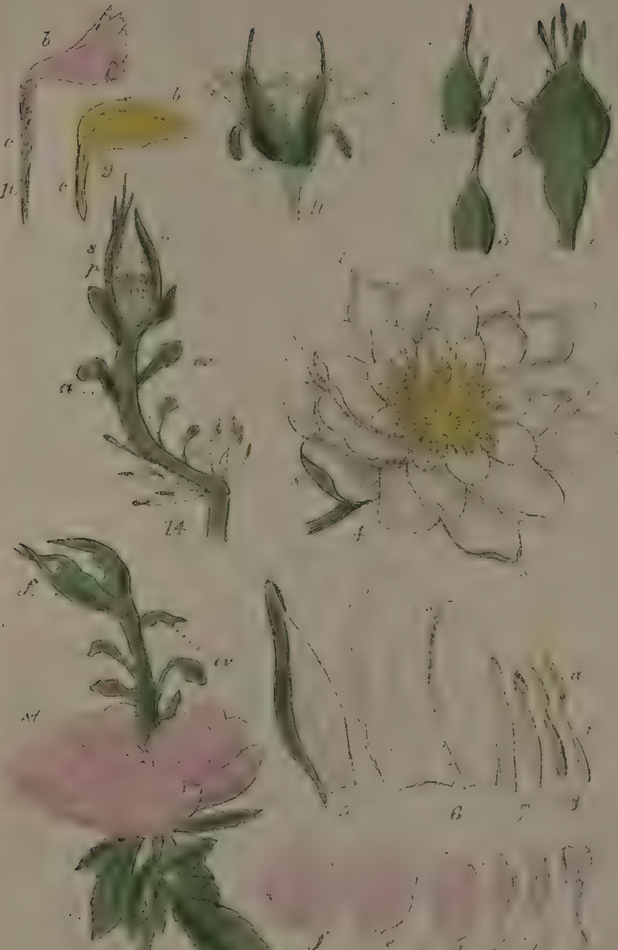
89. The characters of the leaf have already been noticed, and it has been shown that leaves assume two principal modes of arrangement; that of being placed *alternately* and also *opposite* to each other on the stem (pl. 18. f. 6. alternate; f. 7. opposite leaves). In addition to this it must be observed, that in almost all cases in which leaves are placed *opposite* to each other, yet each pair of leaves will be found to be *alternate* with that pair which is above and below it on the stem. Figure 7. represents the stem of the Pimpernel, and shows that the middle pair of leaves are placed in a cross direction to the pair above and below it; if the fourth pair had been produced, it would assume a position which would agree with the middle or second, but would *alternate* with the third below it and the next above it.

This is illustrated in f. 8. in which the leaves of the great Loose Strife are seen to be placed in *threes* on the stem, the lowermost leaves, *a. b. c.* are placed differently to those immediately above them *d. e. f.* and the third row, *g. h. i.* will be found to agree with the lowest, and the fourth set of leaves, *j. k. l.* will agree with the position of the second, *d. e. f.* Thus, in this example in which the leaves are in threes, the rule of alternation still holds good. Figure 9. is the stem of the Madder, with four leaves in a *whorl*, and each whorl will be found to *alternate* with the one above and the one below it.

Thus we find, not only an *alternate* arrangement of leaves, but also an *opposite* position of these organs. This rule is well worthy of remark, as it is one by which the nature of other organs is determined.

90. Next to the leaves we have noticed certain organs, which to an inattentive observer would scarcely be deemed to partake of the nature of leaves; namely, *bracts*: they are leaves diminished in size, and often altered in colour, and in some plants they pass by very slow gradations from the condition of leaves to that of bracts. There can be no doubt that the bract of the Arum Lily is a leafy organ, or that the small green parts surrounding the flowers of the Daisy, Sunflower, or Marigold are of the same nature.

91. Let the bud of a Rose be examined just before it has commenced blowing; (pl. 19. f. 1.), in this, five sepals will be found enclosing the petals, and one of them will be seen to be outermost to all the others, and to possess several small leafy appendages on its margins and one at its apex, (f. 1. *s.*): these represent the diminished leaflets of a Rose leaf. If this sepal be compared with the two next outermost (f. 2.) it will be found that these appendages are fewer as the sepals are placed nearer to the petals: so that the two innermost (f. 3.), or those which are covered in the bud by the three exterior, are provided with only one little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appendage, and that at the end of the sepal. This shows how gradual in some cases, is the passage of a leafy organ to another form. But in the Wallflower, and Stock, there is no such gradual passage from the condition of leaf to that of sepals; yet these partake quite as much of the leafy character, as do the sepals of the Rose. The bud of the Peony gives a similar illustration as the Rosebud.

92. The petals also partake of the nature of leaves, although from the variety of their colours they are not likely to be so considered by the generality of observers. There are, however, many facts which establish this point. In the flower of the Lily (pl. 14. f. 9.), the outer row (*c*) of the perianth (par. 53.) will be found to be marked with green on the back, which is not the case with the inner; and yet there is no other difference in the nature of these organs. A still more striking proof is offered in the flower of the white Water Lily (pl. 19. f. 4.), in which the calyx consists of four sepals (*s*.), which are tinged with green on the outside, but are white inside (f. 5.). The petals (f. 6.) next to the sepals are white, and nearly of the same form; while those situated more towards the centre of the flower will be found to become smaller and smaller by degrees, and to change their colour from white to yellow, while at the same time the tips of these changing petals (f. 7.) will be found to be furnished with a small yellow thickening, which gradually assumes a larger size as the petal is placed still nearer the centre of the flower, till at length it becomes difficult to determine what is a petal, and what a stamen (f. 8.). There is, in fact, in

this flower a gradual passage from the condition of sepals to that of petals, and from petals to that of stamens; which are also to be considered as modifications of the leaf.

93. We have seen that the leaf proper is sometimes composed of a petiole or leaf-stalk, and the blade; but that the petiole is absent in a great many instances. The petal is occasionally seen to possess a similar form, as in the Wallflower (f. 9.), and Pink (f. 10.), in which there is a claw (*c.*), or narrowing of the petal at its base, which corresponds to the petiole in the leaf, while the broad part (*l.*), answers to the lamina or blade. We find also that the edge of this blade is notched (f. 10.) as in some leaves. In the stamen (f. 8.), the filament (*f.*), answers to the petiole of the leaf, and the anther (*a.*), is the blade transformed into a hollow case, as if the edges of the leaf had never unrolled or expanded into a lamina; and just as the petiole is absent in some leaves, so some stamens are found without filaments.

94. In the foregoing example the petal has been traced to the condition of stamen; but occasionally the stamen in the Cabbage Rose may be traced, degenerating as it were, or falling in the state of petal: f. 12. represents the steps of this change; sometimes a stamen may be found having its anther (*a.*) enlarged and rose coloured on one side; or, lengthened (*b.*) more than usual; sometimes one side of the anther (*c. d.*) assumes the form of a petal, while the other resembles part of an anther; or, as at *e.* it nearly takes the form of a petal; or that of petal and sepal combined, as at *f.*

95. The central organ of the flower, the ovary, also partakes of the nature of the leaf, only the blade is folded and united by its edges, so as to form a hollow case, in which the ovules are formed. The midrib of the leaf forming the back of the ovary, and the united edges of the blade being turned towards the centre of the flower, and having the ovules fixed there. The style is the end of the leaf lengthened out, the very point, or apex of which, forms the stigma.

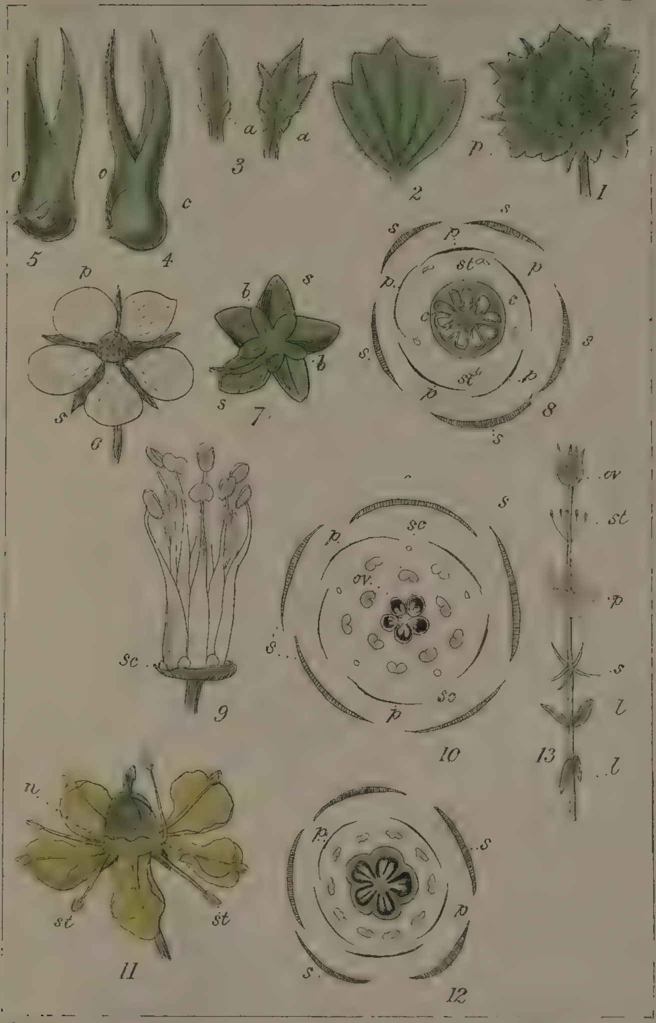
96. One proof of the statement, that the ovary is to be considered as a modification of the leaf, lies in the fact, that in the *double blossom* Cherry, the ovary actually takes the form of a leaf with the margins cut just in the same way as those of the true leaves of the plant (pl. 19. f. 11.); only it never assumes the expanded form, but remains slightly folded together (*ov.*); the end of the leaf tapers also into a style, and is furnished with a brownish stigma. Of course neither seeds nor ovules are formed within it.

97. Another singular proof of the change of ovary to the leafy condition, is seen in the flower of what is termed the *proliferous* Rose, as represented at f. 13. and 14, in which the sepals (*s.*) become changed into real leaves; and the petals are greatly increased in number at the expense of the stamens (*st.*); while the ovaries (*ov.*) which are seen in their natural form and place in pl. 15. f. 1. are changed into leafy organs on the stem which has passed through the flower, and at the end of which, an imperfect flower (*f.*) is found growing; this is seen cut open at f. 14, in which the sepals and petals have been removed to show the stem

on which the changed ovaries (*ov.*), represented by leaves may be seen; at the top the second flower is cut open perpendicularly, showing at *s.* the sepals, *p.* the petals, within which may be seen some stamens and ovaries.

98. But the most conclusive evidence is afforded in the Strawberry of the Alps of Europe, which sometimes becomes transformed from the state of flower to that of leaves. Pl. 20. f. 1. is a representation of such a flower: the calyx is of the usual form and appearance, while the petals (*p.*) assume a green colour, and a lobed form, furnished with very fine hairs; (f. 2. is a petal magnified.). The stamens which are about twenty in number, are enlarged into green leaves with petioles, some are three-lobed (f. 3.), while others are simple; most of them are also furnished with two small yellow bodies (*a.*) at the base of the blade, which are the anthers in a rudimentary state. The carpels (f. 4. *c.*) also degenerate into leaves, and are arranged spirally on the receptacle, which becomes juicy as the flower grows. These carpels contain very minute leaves (f. 4. *o.* 5. *o.*), which represent the ovules. In this singular flower all the several organs destined to provide for and protect the seed, preserve, as it were, their original condition of green leaves.

99. A proof of another kind can be advanced to strengthen the statement, that all the organs of a flower are of a leafy origin: by which it is not intended to imply that these parts ever have been leaves, but are organs which may be produced as leaves, or parts of a flower, according to the way they may be affected in the growth of the plant.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100. It has been shown that when two leaves become opposite on a stem, the pair of leaves above and below is usually placed *alternate* with them and so on; and, when three or four leaves form a whorl, the next whorl above or below *alternates* also with it. If the calyx be considered to be a whorl of leaves, and the petals another, and the stamens, when few in number, say three, four, or five, another; and the ovaries another; these different whorls should be found to follow the same rule as whorls of leaves do on the stem below: and such is the fact, for example, the flower of the Strawberry (pl. 20. f. 7.) has five sepals, and outside these sepals (*s.*) are five bracts (*b.*), which will be found to be placed *alternate* to the sepals. The same arrangement exists with regard to the petals (f. 6. *p.*), which *alternate* with the sepals; thus we have already three whorls of organs which alternate with each other, the bracts with the sepals, and these with the petals.

101. The same rule holds good in the flower of the Flax, in which there are no bracts, but the sepals *alternate* with the petals; f. 8. is a cross section of the flower, showing how the different parts are placed with regard to each other; *s. s.* are the sepals; *p. p.* the petals; there are besides five stamens (*st.*), which may be seen to *alternate* with the petals, but to be placed *opposite* to the sepals, and in the centre may be seen the ovary cut across, and consisting of five carpels (*c.*), each containing two ovules; and these five carpels are placed *alternate* to the five stamens.

102. In the flower of the Rue (f. 11.) we find five sepals, (sometimes only four), five petals, and ten

stamens, that is two whorls of stamens of five each. Now five of the stamens (*st.*) (see also f. 12. which is a section of the flower), *alternate* with the petals, and the other five are *opposite* them; thus we have four whorls of organs arranged *alternately*.

103. There are, however, many flowers which do not bear out this rule, or rather appear to contradict this law of *alternate* arrangement of parts; but this is supposed to be due to the suppression of some parts of the flower, and of this proofs are to be had in the flowers of many plants; one illustration will suffice. In the flower of the Geranium (f. 10.) we find five sepals (*s.*), five petals (*p.*), ten stamens (*st.*), and five ovaries (*ov.*). On examining the relative position of these parts, we find the petals are *alternate* with the sepals, but that the *outer* row of stamens, which are shorter than the five inner, are *opposite* to the petals, instead of being *alternate*. But upon close examination five very small scales (*sc.*) (see also f. 9.) will be seen on the outside of the base of the longer stamens which are between, or *alternate* with the petals: these scales are rudimentary stamens, and which, if produced, would make the arrangement complete as regards the law of alternation. So also at f. 12, the section of the Rue flower exhibits the five ovaries (*ov.*), *opposite* the inner row of stamens, when, by the rule, they should be alternate with them. But in the flower f. 11, may be seen at *n.* a ring surrounding the ovaries, which is considered to be another row or whorl of rudimentary stamens. At f. 13, is given the plan of an ideal flower, showing the *alternation* of all the parts; *l.* the leaves

opposite and alternate, *s.* the sepals alternating with the petals *p.* which *alternate* with five stamens *st.* which again *alternate* with five ovaries *ov.* All the parts of the flower are placed separate from each other, in order to express the idea of so many different whorls.

104. The economical uses to which different parts of plants have been applied, would form a very long list if enumerated in order; but the following very brief account may not be without interest.

105. The SEED is made to furnish many useful and necessary articles of diet and consumption,—the principal of these is flour, which is the albumen of wheat; the testa yielding *bran*: meal, is also the albumen of Oats, Barley, Rye, Peas, Beans, Maize, and other grains. Starch is also obtained from the flour of Wheat. From the Castor Oil seeds and Almonds, are obtained oils which bear the above respective names; Linseed Oil is the product of the seeds of the common Flax. The oily substance called Chocolate is obtained from the roasted seeds of the tree called Cacao; not Cocoa Nut; and Coffee is the roasted albumen of the Coffee seed, or berry. The useful article called *Cotton*, consists of the hairs which cover the seeds of the Cotton Plant.

106. The ROOT furnishes us with Sugar in the Beet Root, and a kind of farinaceous diet in the Carrot.

107. From the STEM of the Sugar Cane, Sugar is obtained, by expression and evaporation. Rice Paper is the stem of a plant of very delicate structure, carefully cut so as to unroll into thin plates, which are afterwards pressed flat. From the bark of a kind of Oak, Cork

is obtained; and the Spice Cinnamon is the bark of a kind of Laurel, or Sweet Bay.

108. The LEAVES of the *Indigo* plant yield the dye called by that name; and *Woad,* a blue dye, is also obtained from the leaves of the plant so called.

109. The unopened FLOWER or Bud of the Clove, a plant allied to the common Myrtle, constitutes the Spice of that name, which is said to be derived from the French word "Clou," from the resemblance it bears to a nail.

110. The PETALS of the Rose yield Otto of Roses, and Rose Water, when distilled: while the yellow dye, called Saffron, is obtained from the stigma of a kind of Crocus.

111. From the rind of the FRUIT called Olive, a very useful Oil is obtained by expression; and Wine is generally made from the juice of the Grape.

DESCRIPTION OF THE PLATES.

Pl. 1. f. 1. A broad Bean ; *h.* the scar or hilum ; *t.* the shell or testa : f. 2. one seed-lobe or cotyledon of a broad Bean, exhibiting at *c.* the heart or corculum, consisting of *pl.* the plumule, and *r.* the radicle : f. 3. the same after growing for some days ; *c.* the cotyledon ; *a.* shows the part to which the other cotyledon was attached ; *s.* the plumule lengthened into a stem ; *r.* the radicle extended into the roots : f. 4. exhibits the main or tap root and rootlets of the round leaved Mallow : f. 5. one seed-lobe or cotyledon of an Almond ; *r.* the radicle : f. 6. seed of Spinach cut open, showing at *e.* the embryo, or young plant, consisting of the radicle, plumule, and cotyledons curled round *a.* the albumen : f. 7. a grain of Wheat ; *e.* the embryo ; the rest of the figure being albumen : f. 8. the same cut lengthways ; *e.* the embryo : f. 9. a grain of Wheat after germinating some days ; *c.* the cotyledon ; *r.* the radicles ; *pl.* the plumule ; the dotted line shows the extent of the albumen : f. 10. the seed of the Barberry cut open ; *e.* the embryo surrounded by *a.* the albumen.

Pl. 2. f. 1. Leaf of an Apple Tree, *p.* the leaf-stalk or petiole ; *l.* the blade or lamina : f. 2. a stem, showing at *s.* the scars or places from which the leaves have fallen off ; *b.* the buds : f. 3. sessile leaves of the yellow Toadflax : f. 4. leaf of the Heartsease ; *b.* the blade narrowing into a small petiole ; *st.* the stipules which are often mistaken in the Violet for the leaf itself : f. 5. leaf of a Vine, consisting of five lobes : f. 6. exhibits the *cutting* of the edges or margins of leaves ; *s.* the serrate margin of a

Nettle leaf; *c.* the crenate margin of the leaf of an Apple Tree; *t.* the toothed margin of a leaf; this differs from the former in having the teeth formed of a *concave* instead of a *convex* outline: f. 7. lobed or divided leaf of the long prickly headed Poppy: f. 8. a decompound leaf of Parsley.

Pl. 3. f. 1. Pinnate leaf of a Rose Tree; *st.* the stipules united to the petiole; *p.* a prickle: f. 2. leaf of an Orange Tree, showing at *a.* a joint or articulation between the blade and petiole *b.* which is dilated or winged; this is a compound leaf, of which the last leaflet only is produced: f. 3. the pinnatifid or lobed leaf of a Water Cress, in which the lobes are closely united to the petiole: f. 4. trifoliate leaf of Clover, the leaflets are collected together at the end of the petiole: f. 5. compound leaf of the Robinia or False Acacia, consisting of nine pairs of leaflets, of which one has fallen off; *st.* the stipules converted into thorns.

Pl. 4. f. 1. *Opposite* leaves on the stem of the Lilac: f. 2. part of a branch of the Lime Tree, exhibiting *alternate* leaves on a stem: f. 3. a whorl or circle of four leaves on the stem of the Madder: f. 4. a thorn or abortive branch of the Sloe.

Pl. 5. f. 1. Flowers of Verbena, each flower is placed immediately on the main stem; this represents an arrangement of flowers composing a *Spike*; in which the lower flowers expand first, the upper last: f. 2. the flowers of the Gooseberry, arranged as a *Raceme*, in which each flower is placed on a stalk *s.* by which it is united to the main stem: f. 3. flowers of a kind of Cherry, in which each flower is placed on a stalk, but the lowermost are furnished with the longest stalks, by which the flowers are placed nearly on a level with each other; a simple *Corymb*: f. 4. *Panicle* of Oats, in which the main stem divides into branches, which divide again into two or three, each bearing a single flower: f. 5. flowers of the Elder, forming a *Cyme*; the flowers are on a level as in the *Corymb*, but the main stem branches like the *Panicle*.

Pl. 6. f. 1. Head of flowers of the Marigold cut open, showing at *f.* a number of flowers closely arranged on the end of the stalk; this arrangement is termed a *Capitule*: f. 2. a head of flowers of the Fennel; at *u.* is seen a number of flowers on stalks of equal length meeting on a stem; this portion is an *Umbel;* these umbels again are arranged in a similar manner on a general stem, as at *a.* forming a *general umbel:* f. 3. a branch of the Lime Tree, showing at *b.* the last leaf of the branch much reduced in size and called a *Bract:* f. 4. the *bract b.* of the Arum, or Cuckoo-pint, enclosing a number of flowers: f. 5. a head of flowers of the Marigold, showing at *b.* a number of small leaves called *bracts*, but when spoken of as a whole, an *Involucre:* f. 6. flower of Jonquill; *b.* the *bract.*

Pl. 7. f. 1. Flower of a Geranium, or Herb Robert; *c.* the *calyx; p.* the *petals; s.* the stamens: f. 2. the stamens *s.* with the calyx and petals removed; five of these are longer than the others: f. 3. the central part of the flower; *p.* the *pistil* composed of five ovaries; *c.* the column consisting of five *styles* united; *s.* the five *stigmas:* f. 4. exhibits the pistil arrived at maturity; *o.* the *ovaries* separating by means of their styles, curling upwards to allow the escape of the seeds: f. 5. the calyx of the common Mallow surrounded by three small leaves called *bracts:* f. 6. flower of the large Mallow; *c.* a part of the *calyx; p.* the *petals*; *s.* the stamens: f. 7. the flower cut open; *p.* a petal; *o.* the *ovary:* f. 8. the stamens united by their filaments into one bundle: f. 9. the pistil, consisting of many ovaries, *o.* contained in the calyx after the removal of the petals and stamens; *s.* the united *styles:* f. 10. *o.* the ripe *ovaries.*

Pl. 8. f. 1. Flower of Buttercup; *c.* the calyx; *p.* the petals: f. 2. the same: f. 3. a petal separated: f. 4. a vertical section of the flower, exhibiting at *s.* the stamens inserted on a part distinct from that on which the petals or sepals of the calyx are placed; *o.* the ovaries: f. 5. a stamen; *f.* the filament; *a*, the anther or pollen case: f. 6. *o.* an ovary cut open, containing an ovule or unripe seed; *s.* the style; *st.* the stigma: f. 7. flower and flowerbud of the single Pink; *b.* the *bracts; c.* the tubular calyx; *p.* the petals: f. 8. a petal separated: f. 9. a section of the ovary, and six out of ten of the stamens; *s.* the stamens are inserted *below* the ovary; *st.* the stigmas: f. 10. the ripe fruit or *capsule* burst open.

Pl. 9. f. 1. The thickened roots of the Dahlia : f. 2. roots of the Radish cut perpendicularly, showing at *c.* the *collar* or neck, the point at which the stem and root unite : f. 3. creeping stem or *runner* of the Strawberry ; *b.* is the stem of the plant, which takes root, throws out leaves, and passes on again as a *runner* : f. 4. stem of Iris ; this is an underground stem, called also a root-stock or *rhizome*, which gives off a number of roots : f. 5. scaly bulb of the White Lily, commonly mistaken for a root ; *r.* the roots ; *sc.* scales, the rudiments of leaves surrounding *a.* the axis or stem : f. 6. coated or tunicated bulb of the Leek ; *c.* the collar, a thin plate-like part from which the true roots *r.* descend; *sc.* scales or rudimentary leaves : f. 7. the same cut perpendicularly ; *c.* the collar ; *sc.* a scale ; *b.* a bud or clove ; *a.* the axis or stem : f. 8. solid bulb of Meadow Saffron ; showing at *a.* the bulb which flowered the year before ; *b.* the bulb of the present year ; *c.* the part at which will be found the bulb of the next year.

Pl. 10. f. 1. A magnified view of a part of a *cross* section of Maple ; *w.* the woody part of the first year's growth ; *b.* the green bark: f. 2. is a vertical section of the same, the letters signify the same parts : f. 3. a magnified view of a horizontal or cross section of a Maple stem four years old, exhibiting at *w.* 1. the wood of the first year's growth ; *w.* 2. that of the second, and so on, 3. 4. each year's growth is separated by a number of large openings or rings which are the vessels of the stem seen cut across ; at *b.* 1. is seen the bark of the first year's growth ; 2. 3. 4. that of the subsequent years ; at *c.* is a deposit which will become converted in the fifth year into wood and bark, thus the wood of the fourth year *w.* 4. will be separated from its bark, *b.* 4. by new wood and new bark ; this section shows that the wood is added to, or increased every year by additions on its outside, while the bark is increased by additions on its inner side : f. 4. is a cross and vertical section of a piece of a stem which has been seven years growing ; *p.* the pith, surrounded by the wood of the first year ; the figures, 1. 2. &c. mark out the layers or rings of wood which have been formed during the several years ; the bark is not represented : f. 5. a cross or horizontal section of a stem seven years old ; the pith is seen in the centre, from it a number of fine lines called *pith rays*, or *medullary rays*, pass out to the bark, *b ;* the several layers or rings of wood are dotted off : f. 6. a piece of a Stem of the Cork Oak seven years old cut across ; *p.* the pith ; *w.* the wood in seven layers, with the *pith rays* passing to the bark, *b.* which is in seven layers, the innermost or dark portion being the most recent.

Pl. 11. f. 1. *Lanceolate* leaf of the common Mezereon : f. 2. *orbicular*, or shield like leaf of the garden Nasturtium : f. 3. *angular* leaf of the Goosefoot : f. 4. *spear-shaped* leaf of Convolvulus or Bindweed : f. 5. *digitate* leaf of Monkshood : f. 6. *decurrent* leaf of the Comfrey ; in which the blade runs down part of the stem : f. 7. *perfoliate* leaf of the Haresear.

Pl. 12. f. 1. *Pinnate* leaf of the Bitter Vetch : f. 2. *bipinnate* leaf of an Acacia : f. 3. hairs of different kinds ; *a.* a simple hair, composed of one cavity ; *b.* a simple branched hair of one cavity, or cell ; *c.* a compound hair of the Bryony ; *d.* compound hair of Lychnis ; *e.* *stellate* hair of Hollyhock ; *f.* a simple glandular hair ; *g.* a gland from the Cabbage Rose : f. 4 a stinging hair of the Nettle, magnified ; *b.* the bulb, or thickened portion which is imbedded in the leaf ; the tube or upper part contains also a number of minute grains floating in a fluid : f. 5. and 6. stem of a Grass and Wheat ; the blade surrounds the stem by its petiole or leaf-stalk, *p.* and ends at the joint below : f. 7. *pinnate* leaf of a Vetch ending in a *tendril :* f. 8. part of a stem of Furze with leaves reduced to a spine-like condition : f. 9. the various ways in which leaves are folded up in the bud, termed *vernation ;* the figures represent cuttings of the leaf or of the buds ; *a.* the way in which the halves of a Rose leaf are folded together face to face, the *conduplicate* vernation ; *b.* cross section of Rosemary leaf, in which the edges of the leaf are rolled back, the *revolute* vernation ; *c.* the leaf of the Apple, the edges are rolled inwards, *involute* vernation ; *d.* the way in which the leaf of the Maple and Vine is folded in plaits, *plicate* vernation ; *e.* section of leaves in a bud in which the outer leaves overlap the inner at their edges and margins, *overlapping*, or *imbricate* vernation; *f.* the mode in which the leaf of a Fern, or of the Sundew is rolled up to its apex, *spiral*, or *gyrate* vernation; *g.* the *obvolute* vernation, in which two conduplicate leaves overlap each other: f. 10. *Cupule* or cup of the Acorn, composed of a number of *bracts*: f. 11. leafy cupule of the Hazel Nut.

Pl. 13. f. 1. Calyx of the Pimpernel, or Poor Man's Weather Glass, consisting of five sepals: f. 2 *tubular* calyx of Pink and Sweet William, consisting of five sepals united; *t.* the tube terminated by teeth; below, the calyx is surrounded by two bracts: f. 3. *tubular* and *angular* calyx of Primrose and Cowslip composed of five sepals united: f. 4. *inflated* calyx of the Catch-fly: f. 5. *bellshaped* calyx of Thrift: f. 6. *monopetalous* corolla of the Dead Nettle, divided into two lips, an upper and lower; this is called a *labiate* corolla: f. 7. spurred calyx of the garden Nasturtium; *s.* the spur of one of the sepals: f. 8. *partite* or *cleft* calyx of Henbane; called also from its form, an *urceolate* or *urnshaped* calyx: f. 9. section of the flower of the Fuschia, the lower part is a *cross* section, exhibiting four cells or cavities *o.* containing young seeds; the upper is a perpendicular section, exhibiting at *c.* the calyx, united closely to the ovary *o.* below; *s.* four stamens inserted into the calyx; *st.* the stigmas of several styles united; the style below is seen descending to the top of the ovary: f. 10. flower of Cucumber, showing the calyx *c.* adhering to the ovary and surmounting it: f. 11. *monopetalous* corolla of Convolvulus or Bindweed; *t.* the tube; *l.* the limb of the corolla; f. 12. *campanulate*, or *bellshaped* corolla of Campanula or Canterbury bell.

Pl. 14. f. 1. Petal of the Pink; *c.* the claw; *l.* the lamina; *a.* is a petal of the Buttercup, consisting of lamina only: f. 2. *rosaceous* corolla of Sweet Briar, composed of five petals with very short claws: f. 3. *pink-like* or *caryophyllaceous* corolla, in which the claws of the petals, see f. 1. *c.* unite into a kind of tube, and the lamina expands into a flat surface: f. 4. *cruciform*, or *cross-like* corolla of Wallflower, consisting of four petals arranged in a cross form, claws either long or short: f. 5. *papilionaceous* corolla of Sweet Pea, consisting of five petals of various forms; *v.* the *standard*, or vexillum; *a.* the two *wings* or *alæ; c.* the *keel,* or *carina,* composed of two petals slightly united: f. 8. *funnelshaped* corolla of Tobacco; f. 7. *salver shaped* corolla of Primrose: f. 8. *personate* or *masked* corolla of Snapdragon, differing from the *labiate* corolla in the lips being closely pressed together: f. 9. flower of the Lily, showing that the calyx and corolla are not distinct from each other except as to position; *c. c. c.* the outer row represents the calyx; while the three inner ones the petals; the whole is termed a *perianth:* f. 10. *rotate* or *wheel shaped* corolla of Speedwell seen from below.

Pl. 15. f. 1. A perpendicular section of a Rose, showing the ovaries contained in the calyx; *s.* the stamens placed on the calyx with the petals: f. 2. section of the flower of a Buttercup; *s.* the stamens placed distinct from the petals and sepals on the axis or stem continued upwards: f. 3. a stamen; *f.* the *filament; a.* the *anther*: f. 4. stamens of Pink placed below the ovary: f. 5. flower of Cherry, showing that the stamens *s.* are placed upon the calyx: f. 6. section of a flower of the Fennel, showing at *s.* the stamen placed upon the top of the ovary: f. 7. section of the corolla of the Cowslip, in which the stamens are seen fixed to the corolla: f. 8. stamens of the Mallow united into one bundle, *monadelphous* stamens: f. 9. flower of St John's Wort, exhibiting three sets or bundles of stamens; *polyadelphous* stamens: f. 10. one of the bundles separated: f. 11. stamens of the Pea, in which nine are united into one bundle, and one (on the left) is separate; *diadelphous* stamens: f. 12. stamens with the anthers in different positions on their filaments; *c.* the *connective,* or continuation of the filament to which the anther is *adnate,* or fixed by its length; *d.* stamen of Cherry, the anther is *innate,* supported on the *end* of the filament; *e.* stamens of Grass, in which the anther is able to move or oscillate on the end of the filament: f. 13. anther of Potato flower, opening by two *pores* or *holes* at its apex, instead of lengthways, as in f. 3. f. 14. anther of Barberry opening by a valve curling upwards: f. 15. triangular pollen of Evening Primrose: f. 16. elliptical pollen of a kind of Onion: f. 17. globular pollen of a Gourd: f. 18. globular pollen of an Almond represented bursting.

Pl. 16. f. 1. Young ovary of a Pea; *o.* the ovary with the ovules in it ; *s.* the style ; *st.* the stigmas : f. 2. nearly ripe ovary of the Pea opened : *ov.* the *ovules* or unripe seeds : f. 3. united ovaries of Geranium ; *st.* the stigmas at the end of the united styles : f. 4. *ov.* the united ovaries of the Mallow contained in the calyx : f. 5. three ovaries of Peony in the calyx : f. 6. ovaries of Buttercup arranged on a receptacle *r.* f. 7. five separate ovaries of Love in a mist, with their styles : f. 8. three united ovaries of Lily, with style and stigma *st.* also united : f. 9. cross section of the fruit of Primrose, showing the ovules in the centre : f. 10. section of Orange ; *p.* the partitions formed by the union of the sides of two ovaries; the seeds are fixed at the narrow end of each carpel or ripe ovary : f. 11. a single ovary of the Orange removed and cut across : f. 12. a cross section of the fruit of the Lily composed of three ovaries united; and two rows of seeds in each ovary : f. 13. cross section of a young Poppy head ; showing the ovules fixed on the partitions, which do not meet in the centre : f. 14. section of the fruit of Violet, and Heartsease, composed of three ovaries united so as to form one cavity, and bearing the ovules *o.* on the side : f. 15. ovary of Ladies' Mantle, showing the style is sometimes attached to the lower part of the ovary : f. 16. ovary of Poppy, showing the stigmas *st.* seated on the top, the styles being absent : f. 17. ovary of Dead Nettle with united styles and two lobed stigma : f. 18. two styles of Pink.

Pl. 17. f. 1. Fruit of Violet or Heartsease burst open, with the seeds : f. 2. opening of the fruit of Campanula by holes, *h. h.* f. 3. capsule of Chickweed opening by teeth at its top : f. 4. carpels, or ripe ovaries of Buttercup seated on *r.* a receptacle or continuation of the stem ; *o.* a carpel cut open showing the seed: f. 5. fruit of Strawberry, in which the carpels *c.* are arranged on a *juicy receptacle* : f. 6. the same cut perpendicularly to show *r.* the receptacle : f. 7. Raspberry in which the ovaries are seen in f. 8. placed upon a white *dry receptacle* : f. 9. Gooseberry, crowned by the calyx *c.* f. 10. the same cut across, showing the position of the seeds *s. s.* and the cords by which they are fixed to the sides of the compound ovary : f. 11. cross section of an Apple ; *a.* the Apple or eatable portion ; *ov.* the ovaries or core, containing pips or seeds ; *a.* is the calyx enlarged and united to the ovaries as seen in f. 12. *c.* the calyx crowning the Apple ; *ov.* the ovaries : f. 13. the Peach ; *p.* the part eaten ; *s.* the stone.

Pl. 18. f. 1. An Acorn in its cup or cupule : f. 2. young fruit of the Oak or Acorn cut across ; *ov.* three ovaries, containing each two ovules : f. 3. siliqua of the Wallflower bursting : f. 4. a Fig cut open, showing at *f.* the flowers contained in it ; these flowers consist only of stamens and pistils : f. 5. fruit of Mulberry; in which the ovaries form a mass : f. 6. alternate leaves of the yellow Toad Flax ; f. 7. opposite leaves of the Pimpernel ; the middle pair are placed *alternate* to the pair above and below : f. 8. stem of the Loosestrife with three leaves in a whorl ; showing that the whorl of leaves, *a. b. c.* are placed *alternate* to those of *d. e. f.* and that *g. h. i.* agree with *a. b. c.* as to position ; and *j. k. l.* with *d. e. f.* f. 9. stem of Madder with four leaves in a whorl, showing a similar arrangement.

Pl. 19. f. 1. A Rosebud, showing that the outer sepal *s.* is furnished with small leafy appendages answering to the leaflets of the leaf : f. 2. the third sepal : f. 3. the fifth or innermost which has no appendages except the one at the apex : f. 4. flower of the Water Lily ; *s. s.* the four sepals, which are green outside and white within : f. 5. a sepal : f. 6. two petals : f. 7. two, more internal petals reduced in size, and showing traces of anther at the top : f. 8. two stamens ; these five figures exhibit the gradual passage of the sepal to the condition of petal, of petal to that of stamen : f. 9. a petal of the Wallflower ; *c.* the claw ; *b.* the blade : f. 10. petal of Pink : *c.* the claw ; *b.* the blade : f. 11. flower of *double blossom* Cherry ; *ov.* the two ovaries changed into leaves : f. 12. *a. b.* a stamen of the Cabbage Rose beginning to assume a petal-like form ; *c.* a stamen in which one half of the anther is expanded into a petal-like part ; *d.* a stamen expanded into a petal having lost its filament, and retaining half the anther ; *e.* an irregular petal ; *f.* a petal placed near the calyx, and assuming a kind of midrib : f. 13. the Proliferous Rose, in which *s. s.* are the sepals expanded into true leaves and surrounding the petals ; *st.* the stamens placed on the stem which passes through and bears *ov.* some abortive ovaries, and at its summit another flower *f.* which is seen cut in f. 14. in which the petals and sepals are removed; *s. s.* the sepals of the second imperfect flower, containing *p.* the petals, stamens, and ovaries.

Pl. 20 f. 1. Flower of the Alpine Strawberry, in which all the parts are changed into leaves; *p.* the petals: f. 2. a petal removed, showing its lobed form, and fringed edge; (compare this with a petal in f. 6.): f. 3. two stamens changed into leaves, but retaining traces of the anther, *a.* f. 4. a carpel *c.* changed into a leaf, containing *o.* an ovule, changed into a leaf: f. 5. the same parts cut open: f. 6. *p.* the petals of the Strawberry seen to be *alternate* with the sepals *s.* which in f. 7. *s. s. alternate* with the bracts *b.* f. 8. a plan of the flower of Flax; in which *s. s.* represent the five sepals; placed within and *alternate* are five petals *p. p.* within which, are five stamens *st. alternate* with the petals; and five carpels *c.* each containing two ovules, *alternate* with the stamens: f. 9. stamens of the Geranium; *sc.* the scales or rudimentary stamens: f. 10. a plan of the Geranium flower; *s. s.* the five sepals; *p. p.* five petals *alternating*; *sc.* five scales or rudimentary stamens *alternate* with the petals; then come five outer stamens *alternate* with the scales, and five inner *alternate* with the five outer stamens which also are shorter; and five ovaries *alternate* with the five inner stamens: in this figure six sets or whorls of floral organs are seen arranged *alternate* to each other: f. 11. flower of the Rue; *st.* five outer stamens; *n.* the nectary or rudimentary set of stamens: f. 12. is a plan of the same flower; *s. s.* the sepals *alternate* with the petals *p.* the stamens are in two rows of five each; the inner row *opposite* to the ovaries, between which and the stamens exists the ring *n.* seen in f. 11. the nectary, or rudimentary set of stamens which if produced would make the *alternate* arrangement of all the parts of the flower complete: f. 13. an ideal arrangement of all the parts of the flower in *alternate* succession; *l. l.* the leaves; *s. s.* the sepals, *alternate* with *p.* the petals; *st.* the stamens *alternate* with the petals below and the ovaries *ov.* above.

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